ENGINEERING NEWS

A JOURNAL OF CIVIL, MECHANICAL, MINING AND ELECTRICAL ENGINEERING

Vol. [illegible]. No. 25. 220 Broadway, New York, December 17, 1908.

TABLE OF CONTENTS.

	Page.
LEADING ARTICLES:	
The Improvement of the Detroit River for Navigation (illustrated)	661
Spur Bearing on Heavy Railway Motor Equipments (illustrated); Norman Litchfield	664
The Manufacture, Erection and Demolition of Farms for Concrete Work; Francis W. Wilson	665
Automatic Devices for Measuring Water Used for Irrigation (illustrated); F. W. Hanna	666
The Temporary Bridge Across the Cornwall Canal and the Permanent Repairs to the Canal Break (illustrated)	668
A Proposed Sanitary District for Northern Indiana	670
The Hydraulic Method of Handling Earth	671
Proposed Structural Improvements for the Elevated Terminal Loop at Chicago (illustrated)	672
The De Muralt System of Reinforced-Concrete Foreshore Protection (illustrated); Rudolph Welcker	674
How a Private Gas Company at Indianapolis is Controlled in the Public Interest; Charles Carroll Brown	675
A Tablet to the Memory of Andre-Marie Ampère (illustrated)	676
Inland Waterways; Extract from the President's Message	676
Reminiscences of a Gas Engine Designer (illustrated); L. H. Nash, M. Am. Soc. M. E.	681
The Need for Conserving the Mineral Resources of the United States	683
A Wedge Fastening for Steel Ties (illustrated)	684
A New Type of Jig for the Separation of Metallic Ores (illustrated); Arthur Taylor	685
Hearing on the Proposed New York Harbor Outlet for the Passaic Valley Trunk Sewer	686
EDITORIAL	677
The Value of Derailing Switches—No More Ash Burning in New York Schools.—A Bird of a Bridge Investigator.	
Shall the United States Borrow Money for Inland Waterways?	677
A Scientific Scheme for Sewage Disposal by Dilution in New York Harbor	678
LETTERS TO THE EDITOR	679
The Question of River Protection; W. R. De Witt—A Proposed Department of Public Works; Theron M. Ripley—The Minneapolis Building Department Tests of Plain and Reinforced Concrete Columns; Edward Godfrey—Methods of Stress Calculation for the Blackwell's Island Bridge; A. Streiff—Notes and Queries.	
ENGINEERING NEWS OF THE WEEK	687
PERSONALS	688
ENGINEERING SOCIETIES	688
ENGINEERING LITERATURE SUPPLEMENT	689

THE IMPROVEMENT OF THE DETROIT RIVER FOR NAVIGATION.

In order to provide for the increase in traffic on the Great Lakes, and for the increase in the size of steamers engaged in this traffic, the United States Government has for several years been at work upon improvements to the harbors on the Great Lakes and to the straits (or so-called rivers) which connect these lakes. The straits have many shallow places, and most of the improvement work has been in the establishment of wide and deep channels for navigation. An important piece of work of this kind is now in progress for the improvement of the Detroit River, which is the southern part of the strait connecting Lake Huron with Lake Erie. A map of the lower section of the river, showing the deep water channels, is given in Fig. 1. The work is under the direction of Lieut. Col. C. McD. Townsend, Corps of Engineers, U. S. Army, to whom we are indebted for information as to the general project. Mr. Chas. Y. Dixon, Assistant Engineer, is in charge of the work.

PRESENT AMHERSTBURG CHANNEL.

The project adopted in 1892 provided for a minimum channel width of 600 ft. all the way from the city of Detroit to Lake Erie, with a depth of 20 ft. of water at a mean stage of Lake Erie 572.8 ft. above sea level. In 1902, this was changed to a depth of 21 ft. below low water in Lake Erie (stage 571 ft. above sea level). The route adopted for this channel begins in midstream just below Fighting Island and swings over to the Canadian shore, passing through the narrow reach between Bois Blanc Island and Amherstburg, Ontario. It then swings back again towards midstream. The present condition of this channel, called the Amherstburg Channel, is as follows (see Fig. 1):

The Ballards Reef channel has a width of 600 ft. and a depth of 19.2 ft. and has not yet been deepened to the project depth.

The Limekiln Crossing channel has been practically completed, with the exception of the upper part. There the channel has the full depth for 450 ft. on the west side, and the widening of the easterly 150 ft. is at present under contract with the Dunbar & Sullivan Dredging Co., of Buffalo, N. Y. This work will be finished this fall.

The Amherstburg Reach channel has 600 ft. width and 21 ft. depth.

The Hackett Range has a width of 600 ft. and a depth of 21 ft., with the exception of a small area on the east side of the channel. The completion of this is under contract with Mr. M. Sullivan, Buffalo, N. Y., and the work will be finished this year.

The Bar Point Shoals channel has the easterly 700 ft. unimproved, with a least depth of 18.2 ft. The westerly 400 ft., to deep water in Lake Erie, is improved to 21 ft. depth.

From the above (and to the southeast of the Detroit River Light House, Fig. 2) to deep water in Lake Erie, the channel is under improvement, and nearly finished for a width of 800 ft. and depth of 22 ft., under the Livingstone Channel contract.

THE NEW LIVINGSTONE CHANNEL.

In 1907, Congress passed an act authorizing the further improvement of the facilities of navigation for large vessels of deep draft by the formation of a new and direct channel, which is practically a chord to the arc formed by the present deepwater channel, described above. This is to be known as the Livingstone Channel, and will have a minimum depth of 22 ft. of water at a Lake Erie stage of 571 ft. above sea level. The width is 300 ft. for the upper part, widening to 800 ft. from abreast of Bar Point to deep water in Lake Erie. This channel is expected to be completed in the spring of 1911. It will be used by down-bound vessels, up-bound vessels taking the Amherstburg Channel.

The improvement of this new channel is being done under four contracts, as follows:

Section 1: 10,000 ft. long, 300 ft. wide and 22 ft. deep. The Great Lakes Dredge & Dock Co., Chicago, Ill.

Section 2: 8,500 ft. long, 300 ft. wide and 23 ft. deep. Grant Smith & Co. and Locher, Grosse Isle, Mich.

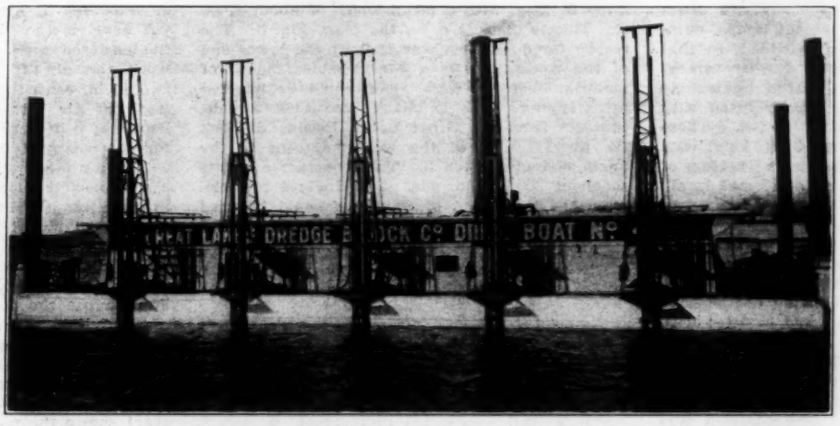
Section 3: 18,250 ft. long, 300 ft. wide and 22 ft. deep. P. B. McNaughton and O. G. Dunbar, Buffalo, N. Y.

Section 4: 29,000 ft. long, 800 ft. wide and 22 ft. deep. G. H. Breymann & Bros., Toledo, O.

The heaviest and most interesting part of the work is on Sections 1 and 2. About one-third of Section 1 and three-fifths of Section 2 are enclosed by cofferdams, as shown on the map. The cofferdams for the middle part are completed and pumping is under way. After the enclosed area was partly drained, excavation of the channel commenced and will be continued summer and winter until completed. The channel above and below the cofferdams will be excavated in the wet by means of drill boats and dredges. These two methods may be described separately.

ROCK EXCAVATION IN DEEP WATER.

The general method employed is to drill blast holes by means of drills mounted on barges or drill boats, and to remove the rock by dredging. The rock is a compact limestone, but with seams in the lower strata. The contract for the north end of the channel is held by the Great Lakes Dredge & Dock Co., of Chicago. This section is 5,800 ft. long and 300 ft. wide, and has a net area of 180,000 sq. yds. The rock is practically bare of overlying material, and the average depth of water is 16 to 18 ft. The work on this section is described below, from information furnished by the contractors.



DRILL BOAT FOR ROCK EXCAVATION UNDER WATER; IN USE ON THE DETROIT RIVER IMPROVEMENT.

The drill holes are 3 ins. diameter, with an average depth of 8 ft. and a maximum depth of 12 ft. They are about 6 ft. apart in both directions. An 8-ft. hole can be put down in about 20 minutes, and the plant (operating nine drills) can finish about 250 holes per eight-hour day. The charge for an 8-ft. hole is 8 lbs. of 60% dynamite. A dipper dredge having an 8-yd. dipper fitted with steel teeth excavates the loosened rock to the proper grade. A sweep, consisting of a long steel rail suspended from a barge at the required depth, is then towed over the excavated section. The small lumps encountered by this are removed by blasting. The boulders are removed by a derrick scow, the grapples of which are attached by divers. The plant used comprises two drill boats (one with five and one with four drills), a dipper dredge, a derrick scow, and the necessary equipment of dump scows and tug boats. The excavated material is deposited at a dumping ground established by the U. S. Government at a maximum distance of two miles.

The larger of the two drill boats was built specially for this work, and is built entirely of

steel. It was built by the contracting company at its Cleveland shops, and is said to be the first steel drill boat on the Great Lakes. A view of this drill boat is shown in Fig. 2. The hull is 132 × 33 ft., and 7 ft. deep, with a normal draft of 4 ft. It is divided into five watertight compartments by steel bulkheads, and there are no doors or other openings in these bulkheads. The boiler room, pump and engine room, coal bunker (40 tons capacity), store room, repair shop, office, and living rooms are all contained within a steel deck house. This is set to one side of the center line of the hull, in order to give a wider platform along that side of the deck which has the drilling apparatus. The drills are suspended in vertical frames or leaders, which are attached to carriages running on rails on the deck. The carriages are operated by hydraulic power, for which purpose two large pumps are provided. Steam is supplied by a marine boiler carrying 125 lbs. pressure.

The engine room contains the pumps, the air compressor, and the engine and 125-KW. belted dynamo for electric lighting. There are about 150 fixed and portable incandescent lamps, numerous plug attachments being provided, so that the portable lamps can be placed wherever required. There are also two search lights. At each end of the hull are two spuds fitted with racks and operated by steam power. These spuds are timbers 22 × 22 ins., 40 ft. long, with a maximum reach of 30 ft. below the bottom of the hull. The vessel has a crew of 17 men in all, when at work (including the engineman, drill men, and all other employees on board).

The derrick scow is 95 × 27 ft., with a stationary A-frame derrick having a timber boom 68 ft. long. It can handle loads up to 15 tons. The cable is operated by a hoisting engine having two cylinders 9 × 13 ins., and is fitted with grapple arms.

ROCK EXCAVATION WITHIN COFFERDAM.

Section No. 2 of the work is 7,500 ft. in length, and involves the excavation of about 1,352,000 cu. yds. of rock and earth. The contract was let to the firm of Grant Smith & Co. and Locher, of Thorice, Mich. They decided to do the work in the dry, enclosing the work by a cofferdam, thus following the method successfully employed by them as subcontractors for the West Neebish Channel in the St. Mary's River, below Sault Ste. Marie, Mich. (Engineering News, Oct. 10, 1907.) A convenient location for the camp and construction plant was afforded by Stony Island, at the west side of the upper end of the channel. This was leased by the contractors in order that they might have entire control of the camp and its surroundings. The contract provides for the completion of the work in 750 good working days.

The Michigan Central Ry. formerly had a line extending from Grosse Isle (the present terminus, see Fig. 3) across Stony Island, with a pier extending into the river for connection with a car-ferry to the Canadian shore. The car-ferry and the line beyond Grosse Isle were abandoned several years ago. Since then, the two west spans of the combination through-truss bridge over the channel between the islands have been taken down to permit of navigation by small vessels of light draft. The only communication between Grosse Isle and Stony Island at present is by a row-boat or ferry. The contractors propose, however, to build a suspension bridge or a cableway over the gap, so that supplies can be brought in by rail by way of Grosse Isle during the winter. At present, supplies are brought down from Detroit by a steamer, and coal is delivered by barges to a chute on the cofferdam, near the end of the old railway pier.

This pier was strengthened, and proved of great use as a landing and for construction work. It is protected from the running ice by cribs or ice breakers a little distance up-stream. It may be noted that the water level in the river is very variable, and is liable to sudden fluctuations according to the wind. It may rise 2 ft. (or even 4 ft. exceptionally) above the normal level, and this must be provided for in the cofferdams.

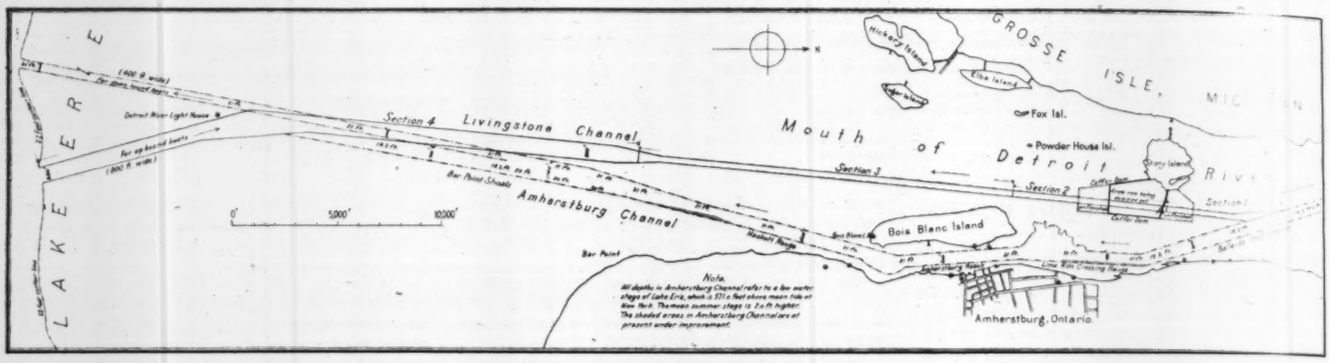


FIG. 2. MAP OF DEEP WATER CHANNELS FOR IMPROVING THE NAVIGATION OF THE DETROIT RIVER.

The total length of the dry excavation on Section 2 will be 4,000 ft., but the first operation was to enclose within the cofferdams an area 2,750 ft. long, with a mean width of about 1,600 ft. This is marked A on the plan, Fig. 3. The reason for doing this was that at the lower end of the work there is a considerable amount of material over the rock which could be handled by dredging. The company also took a subcontract from the Great Lakes Dredge & Dock Co. for 1,500 ft. of the work adjacent to the north end of Section 2. This contract amounts to about 200,000 cu. yds. The dredged material from the lower end of Section 2 could be used conveniently and economically for building the additional cofferdam at the upper end, to enclose the area (D) covered by the subcontract.

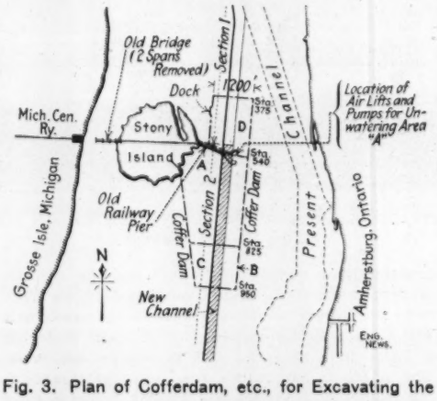


Fig. 3. Plan of Cofferdam, etc., for Excavating the Livingstone Channel in the Dry; Detroit River.

The area A was first enclosed by a cofferdam built of material dredged on the inside, an opening being left at B, which was closed after the dredges had been floated out. The dredges then worked in the lower area C, the material being used to build the cofferdams for this area, and also for the additional area D at the north end. The cofferdam around the combined areas A, C and D is said to be probably the longest ever built. It has a total length of about 16,850 ft., and encloses an area 5,750 ft. long, with a mean width of about 1,600 ft. The coffe[r] about 292,000 cu. yds. of dredged [m]

The cofferdams are formed sim[ply] ing dredged material from scows. [No] piling or sheeting. The material [is] sufficient mixture of stones and [sand] vent rapid washing in the case of [any] the bank. The bank is about 5 [ft.] normal water level and 15 ft. [below] level. No piling is used, the [material] practically watertight. The depth [of] along the line of the cofferdam [varies] ft. to 22 ft. The material was depo[sited] dredges on decked scows which were towed to the unloading point. There a derrick boat was placed with its boom in line with the axis of the dam and extending across the scow. This boom carried a large scraper bucket, which was hauled to and fro across the deck of the scow by inhaul and outhaul lines. In this way a great mass of material was unloaded at each stroke of the bucket. The cost of unloading was but about 4 cts. per cu. yd., or only 20% of the cost of unloading by hand.

A novel method was employed for unwatering the enclosed area. For the great bulk of the work the air-lift system was employed, with two 12-in. centrifugal pumps in addition. There were 50 air lifts, each consisting of a 20-ft. length of 8-in. wrought iron pipe (as used later for the compressed air distribution main), with a 2-in. air pipe attached to it. Two elbows and a nipple on the lower end of the latter reached upward into the bottom of the 8-in. pipe. The pipes were placed in four rows, inclined at an angle of about 40°; the lower ends were about 12 ft. under water, and the upper ends discharged into a wide wooden flume or spillway built across the cofferdam. An air pressure of about 7 lbs. per sq. in. was employed. The plant had a capacity of about 50,000,000 gals. per day.

Fig. 4 shows two views of this air-lift plant at work. The left-hand view (taken from the rear) shows the rear row of 2-in. air pipes; the 8-in. pipes and the rest of the piping are concealed by the rush of water and spray. The discharge flume may be seen at the right of the pile of material on the cofferdam. Beyond the cofferdam are some of the ice-breakers or cribs. The right-hand view shows the outfall of the discharge flume. The stream is 8 ins. deep and 14 ft. wide, with a velocity of 8 ft. per minute.

The pumping was commenced on Oct. 5 and continued until Oct. 19. This lowered the water 6 ft., which exposed sufficient surface to permit of commencing the excavation. The air was then shut off from the air lifts, and the two centrifugal pumps were used to complete the unwatering and to remove any water from seepage or drainage.

The water was from 6 to 15 ft. deep in the enclosed area. The depth of the overburden ranges from nothing to 40 ft., and the depth of rock excavation will range from 3 ft. to 18 ft. The rock is a hard limestone, but it is expected that a softer dolomite (with seams) will be reached in the lower part of the excavation.

The rock is drilled and blasted, the charges being fired by dynamo blasting machines oper-

ated by air-driven engines. Three steam shovels are used to load the material into skips of 2½ cu. yds. capacity. These skips are handled by three cableways which span the work, and the material is dumped along the east side of the channel, leaving a berme of 50 ft. As the rock is removed to form a flat floor, the shovels are mounted upon wide-tired traction wheels, each having a solid plate disk at each side. This arrangement reduces the number of men required and the loss of time incurred in the continual shifting of tracks for the shovels. The shovels have dippers of 1½ cu. yds. capacity.

(A) Rear View of Air Lifts at Work.

(B) Discharge of Flume from Air Lifts.

FIG. 4. AIR LIFTS UNWATERING PORTION OF DETROIT RIVER ENCLOSED BY COFFERDAM.

A cross-section of the work is shown in Fig. 5. The three cableways have each a span of 726 ft., covering the 300-ft. channel, two 50-ft. bermes and the dump pile. One machine will work on the overburden to strip the rock. The others will follow it to handle the excavated rock. In order to save time, they were all erected before the area was unwatered. For this purpose, islands of dredged material were formed at the sites for the towers. The tracks were laid out on these after a triangulation survey by the contractor's engineer (Mr. A. S. Robinson), it being absolutely necessary to have the opposite tracks parallel with each other and with the line of the channel. In this way, the cableways were ready for use as soon as the water was lowered sufficiently to allow of commencing the excavation.

The cableways have the Locher dumping system with differential drum. As soon as the skip is over the location for the dump, the engineman throws the skip cable on the larger diameter of the drum, and the rapid winding of this cable then tilts the skip. This system was first introduced on the Chicago Drainage Canal work by Mr. C. H. Locher. The hoisting engines are operated by compressed air, flexible tube connections enabling each cableway to travel 100 ft. before the pipes have to be shifted.

Compressed air will be used to operate the drills, channelers, cableways and pumps. For this purpose a large power plant has been established on Stony Island. This has two two-stage cross-compound air compressors, with a capacity of 5,300 cu. ft. of free air per min. An 8-in. main (with screw joints) runs east along the old pier, and has a branch of the same size extending south. From these the smaller connecting pipes will be laid as required. Reheaters will be used on the branch lines during the winter. Near the power-house is a repair shop. A coal supply of 6,000 tons will be stored here for the winter. This is now brought down by a coal scow, fitted with a McMyler unloading crane. The coal is loaded in 1½-ton boxes which are stacked on the deck of the scow, and are loaded at the pier onto cars for transportation on the contractor's railway to the storage pile at the power-house.

It is of interest to note that all this construction plant was brought by the contractors from their similar work in the St. Mary's River. The work at Detroit being of the same character and on the same waterway, it was economical to transport the plant and use it over again, although the equipment is large considering the amount of excavation in this contract. The plant thus transferred includes the steam shovels, cableways, power plant, drills, piping, and all accessories. Most of it was loaded upon scows and towed to Detroit. The timbers of the towers were all carefully marked before the towers were taken down, so that they could be re-erected without difficulty on the new work. The frames for these towers were built lying upon the ground, and then raised to a vertical position by a hoisting engine.

The construction camp, as already noted, is on Stony Island, and is under entire control of the contractors. At present about 125 men are employed, but when the work is fully under way there will be some 250 men. The buildings are of frame construction, sheathed with building paper on the outside. There are 35 cottages, besides bunk houses and shop buildings. A school house is provided for the children, and is used also for social gatherings. The buildings are laid out on streets, and there are separate groups of buildings for the Italian and American laborers. There is a store, operated by the contractors. The unmarried American employees get their meals at the dining hall, but the Italians do their own cooking. A hospital is provided. During the summer a doctor visits the island twice a week to look after the health of the men and the sanitation of the camp. In the winter there will be a resident doctor and a nurse. Hogs are kept at the camp for scavenging purposes. No liquor is allowed to be sold, and no shanty boats are permitted to tie-up at the island. Under the law relating to government contracts, the contractors are allowed to work the men only an eight-hour shift each day.

Mr. C. H. Locher, of the contracting firm, is in personal charge of the work, with Mr. George P. Locher as Superintendent. To the former, and to the contractor's engineer, Mr. A. S. Robinson, M. W. S. E. (who was also in charge of the West Neebish Channel work, noted above) we are indebted for much information used in this description.

THE OLD RAILWAY CROSSING OF THE DETROIT RIVER AT STONY ISLAND.

The old railway connection and car-ferry at this point have been mentioned already in connection with the cofferdam construction work. It is of interest to note that some 30 years ago a railway tunnel under the Detroit River at this point was projected, and that a railway car-ferry was operated between Amherstburg and the old pier on Stony Island. Particulars of this have been furnished us by Mr. W. S. Kinnear, M. Am. Soc. C. E., Chief Engineer of the present Detroit River Tunnel Co.

The Toledo, Canada Southern & Detroit Ry., between Detroit and Toledo, was put in operation in 1873. The branch from Slocum Junction to Grosse Isle and Stony Island (see Fig. 3) was built at about the same time by the Canada Southern Bridge Co. The train-ferry service between Stony Island and Amherstburg was established about 1873. It was abandoned about 1883, in which year the Canada Southern Ry. was leased to the Michigan Central Ry. and the cut-off was built from Essex to Windsor (opposite Detroit), diverting the main-line traffic to Windsor, where a car-ferry was established. For eight or nine years later, however, the old slips and tracks at Stony Island and Amherstburg were maintained, and were used occasionally to ferry cars across when the river at Detroit was in bad condition for navigation. The ferry service was finally abandoned about 1890, when the railway line between Grosse Isle and Stony Island was abandoned also.

The Canada Southern Tunnel Co. was organized about 1877 to build a tunnel under the Detroit River near Stony Island. In 1887, a tunnel office was established in the vicinity of the railway yard at Amherstburg, and the enterprise was officially started by digging a small hole and giving a banquet at the site. This was done, probably, to meet charter conditions requiring the commencement of work within a specified time. The hole was very soon filled up, however, and this was the end of the project. It is probable that some holes were drilled on Stony Island, possibly about 1880, in order to determine the character of the material that might be encountered.

IMPROVED BIG-GUN PROJECTILES.—During the past year the bureau has, with the aid of private firms, developed a new design for armor piercers which gives vastly improved accuracy and longer ranges without the loss of any of the qualities of the preceding design. This development constitutes such an improvement as to make it the longest step in advance that has occurred in ordnance material for several years.

* * *

The only important ordnance development during the year has been the adoption of a new form of projectile, to which the air resistance is much less than to the older form, resulting in a considerable increase of flatness of trajectory and striking energy at long ranges.

* * *

A series of experiments were conducted showing that great ballistic advantages can be obtained by increasing the radius of the ogival of all shell. Subsequent experiments show that armor-piercing shell can be so designed and capped as to preserve this advantage, while not sacrificing the prime quality for which they are intended.—From Report of the Chief of the Bureau of Ordnance, Navy Department, 1908.

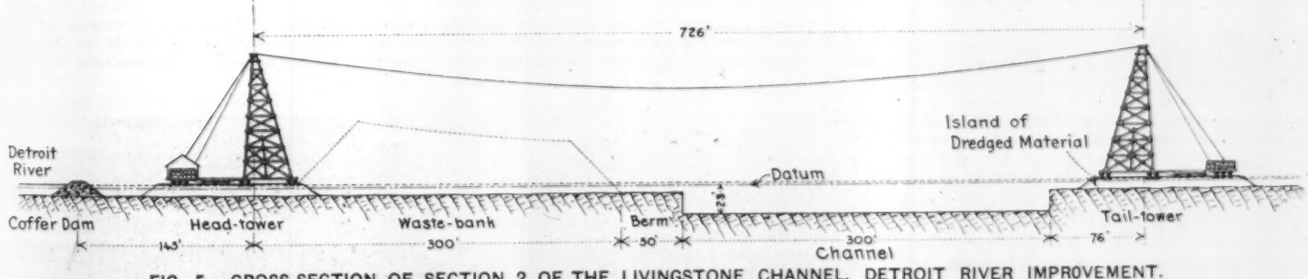


FIG. 5. CROSS-SECTION OF SECTION 2 OF THE LIVINGSTONE CHANNEL, DETROIT RIVER IMPROVEMENT.
(Showing the method of excavation in the dry, by the use of cofferdams, with cableways for handling the material.)

SPUR GEARING ON HEAVY RAILWAY MOTOR EQUIPMENTS.*

By NORMAN LITCHFIELD.†

In the operation of ordinary street railway motors, the gearing is not a serious factor on account of the low horsepower required and it is not until the equipment becomes similar in proportions to that of a steam railroad with congested traffic that its importance begins to be felt. With the installation of electric train service on the Manhattan Elevated Ry. in 1901, however, the gearing question forced itself on the attention of the engineers through the large number of failures immediately occurring. On the New York Subway equipments, the breakages were still more numerous, for these trains are more powerful than any heretofore used, an eight-car subway express train having motors aggregating 2,000 HP., equivalent to a locomotive of about the same power as the new electric locomotives of the New York Central Lines, but differing from the latter in that all the power is transmitted by gears, while the Central's locomotives are gearless.

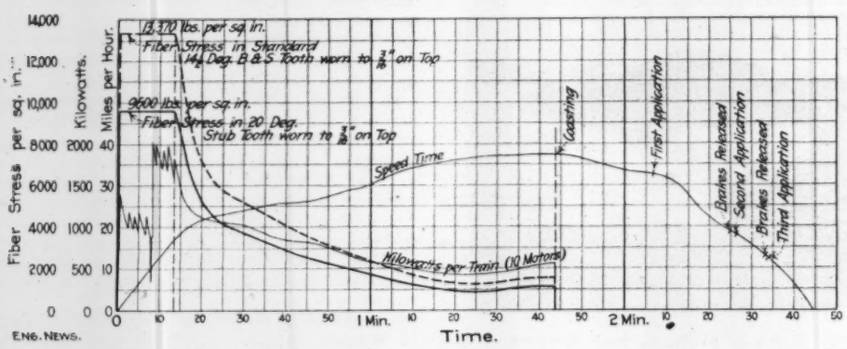
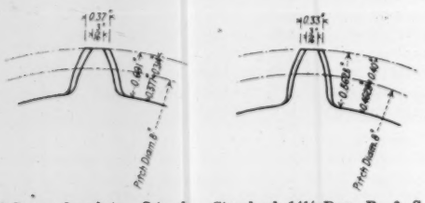


FIG. 1. GEAR TOOTH STRESS AND SPEED-TIME CURVES FOR NEW YORK SUBWAY EXPRESS CARS.
(Stresses calculated by Lewis Method.)

It is evident that the greatest work done by the gearing on any locomotive is during the period of acceleration, and that for given mileage the total amount of work done will depend upon the acceleration, weight accelerated per gear, and total number of such accelerations or starts. During the evening rush hours in the New York Subway, the total load per gear is about 35 tons, and this weight has to be accelerated at the rate of 1.25 miles per hour per second every third of a mile, that being about the average distance between stations.



20-Deg. Involute Stub Tooth (20 Teeth; 2½ Ins. Pitch).

Standard 14½-Deg. B. & S. Tooth (20 Teeth; 2½ Ins. Pitch).

Fig. 2. Outlines of New and Worn Teeth.

How serious a matter the breakage of one gear in the rush hour becomes will at once be realized when we state that at one of the many stub end terminals of the system 37 trains in and out per hour are handled during the period of maximum traffic. For the purpose of comparison, the train movement at the Grand Central Station of the New York Central Lines may be cited, the maximum number of trains there being 35 per hour, and this is, we believe, considered rather extraordinary congestion. One such breakage in the evening rush hour therefore means an inevitable delay to service of half an hour or more and the disruption of the train schedule for the rest of the day, thus entailing great discomfort to the traveling public.

Both the elevated and subway trains of New York are operated by the Interborough Rapid Transit Co., and there is no doubt that the conditions under which their trains operate are unique, further evidence being furnished by the failure of various apparatus other than gears which had proved entirely successful on other roads. We believe therefore that the data obtained by this company may be taken as measures of the limitation of power transmission by gearing in railway service.

Extended studies which we have recently made tend to show that the question of strength has not heretofore received the attention it merited, but that the line of progress followed most sedulously until very recently has been that of increasing the resistance to wear. That this is a highly desirable object cannot be denied, but our experience with the Interborough equipments has shown the most pressing need to be to overcome absolute failure.

It is this phase of the question (absolute failure) which we have felt would be of interest to the society, and so present in this paper the data which we have brought together on the subject.

As is probably familiar to all, the electrical operation of the Manhattan Elevated was commenced some three years previously to the opening of the New York Subway, and our earlier experience was therefore with the equipment for the former. The initial gearing installation on the 125-HP. motors consisted of wrought steel pinions and solid cast steel gears of three diametral pitch, this pitch being adopted on account of the economical current consumption thereby obtained. The pinions at once began to fail at the rate of about 15 per month. The failures continuing, it was decided to withdraw all of the gearing, then in service and replace it with 2½-pitch on account of the greater tooth section thereby obtained, although, as before stated, this meant some loss in economy of current consumption. This change practically ended the failure of the pinions, but not entirely of the cast gears, and it was decided that greater reliability could be obtained by adopting a composite type of gear consisting of a cast steel center on which a wrought steel rim was shrunk. This combination of a wrought steel pinion and wrought rim gear of 2½-pitch has proved generally satisfactory for the elevated service, and the improvement to be looked for is therefore in the line of greater wearing life.

On the Subway Division, the motors are of 200-HP. each and the original gearing equipment consisted of solid cast steel gears with wrought steel pinions, diametral pitch 2½, and teeth of the Brown and Sharpe standard 14½° involute. As on the Manhattan Division, so on the Subway, it soon became evident that the design was not proper, but in contrast to the elevated it was the gears which first caused the trouble. The cast-steel gears, therefore, were all scrapped and replaced by the wrought rim type. (It should be stated that the idea of these composite gears was induced by the experience of the Interborough Company, although they were first brought out in connection with the proposed electric motor car equipments for the New York Central Lines.)

This improvement practically ended the gear breakage, but unfortunately the pinions began to go, the breakages averaging over one a day, and furthermore we find it unsafe to run a pinion the teeth of which measure less than 3/16-in. at the top. We are therefo[re] to scrap material which should be availabl[e]

To what then, shall we look as a remedy? [Sug]gestions have been advanced by the gear m[a]kers:

(a) Diametral pitch less than 2½.

(b) Steel with elastic limit of 90,000 lbs. p[er] over as compared with our present 45,000

(c) 20° stub teeth.

The first suggestion we are unable to acce[pt] of some local conditions, but the combinatio[n] two seems to have possibilities of success and replacing all our gearing with specially trea[ted] steel with stub teeth.

Let us now consider the loads the teeth ha[ve] and determine why it is that we have to re[sort] use of special designs and material in order t[o] gearing stand up.

Fig. 1 illustrates an express run in the subw[ay] the power consumption per train of eight car[s] which are motor cars, each carrying two mot[ors] making ten gears per train. On the same curves are plotted showing the fiber stress in [the] standard 14½° involute and a special 20° involute [both] worn to our present limit of 3/16-in. at top [of] tooth, the tooth outlines being shown in Fig. 2. The [fiber] acting at the pitch line of the tooth has been figu[red] from the power consumption curve and the motor characteristics, and the fiber stress in the tooth has then [been] calculated by the method outlined by Mr. Wilfred Lewis in his paper before the Philadelphia Engineers' Club in 1892, which consists in assuming that all the load is carried by one tooth across its entire face, but at the extreme top, so that the tooth is considered as a beam loaded at one end (the crest) and supported at the other (the base). He states that the force which can be safely transmitted lessens as the speed is increased and gives figures which may be used as safe working stresses at various speeds. These values when plotted give a curve which may be closely represented by the equation

$$S' = S \frac{600}{600 + V}$$

in which

S = safe working stress in lbs. per sq. in. at no velocity.

S' = safe working stress in lbs. per sq. in. at velocity V, in ft. per min.

V = velocity of pitch circle in ft. per min.

Referring to the diagram it will be noted that the worst condition occurs just at the commencement of the motor curve, this being the point at which the gearing is transmitting the maximum torque at the greatest speed obtained during the period of acceleration, the maximum torque occurring, of course, only during this period. Under the conditions shown the fiber stress at this point is 13,370 lbs. per sq. in. in the standard 14½° involute tooth, and at this instant the train is running at 17.3 miles per hour, with a corresponding gear speed of 1,168 ft. per min. On account of this speed, therefore, we require a material which will permit the use of a safe working stress at no speed.

$$S = 13{,}370 \times \frac{600 + 1{,}168}{600} = 39{,}400 \text{ lbs. per sq. in.}$$

The elastic limit of the material we have had heretofore runs about 45,000 lbs. per sq. in. and we therefore have a factor of safety of only 1.1, which is obviously low.

In these calculations we have considered the elastic limit of the material rather than the ultimate strength, on account of the dynamic character of the load, each pinion tooth receiving nearly 1,800 blows per mile. The greater the ratio, therefore, between the elastic limit and fiber stress of the material (the other physical properties remaining of proper value), the greater the life, and some relief should therefore be obtained by the adoption of the special 20° stub tooth which reduces the fiber stress nearly 30% and increases the minimum factor of safety from 1.1 to nearly 1.6.

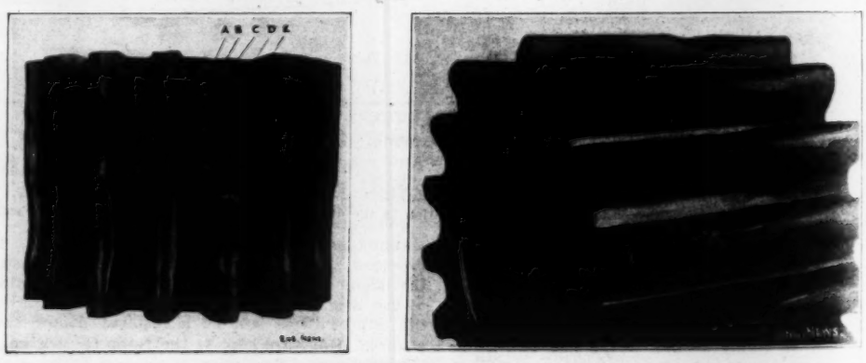


FIG. 3. TWO VIEWS OF NEW YORK SUBWAY MOTOR PINION, 16-TOOTH, BROKEN IN SERVICE.

*Presented at the New York Meeting (December, 1908) of the American Society of Mechanical Engineers.

†Interborough Rapid Transit Co., 98th St. and Third Ave., New York City.

A much greater relief, however, may be looked for by the use of steel with a high elastic limit, say 90,000 lbs. per sq. in., which used in conjunction with a design of stub tooth increases our minimum factor of safety to 3.2 as compared with our present 1.1.

It will be noted that the foregoing calculations are all dependent upon the use of the Lewis formula, the fundamental assumption of which is that the teeth bear across the whole face. Consideration, however, must be given to the fact that in practice it is not possible always

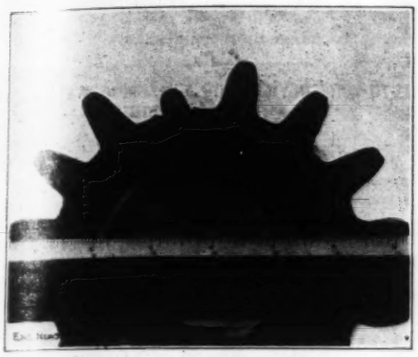


Fig. 4. End View of Pinion Shown in Fig. 3, Showing Cracked Teeth.

to maintain perfect alinement between gear and pinion on account of the necessarily rough design of the motor and its assembly on the truck. The effect of this disalinement is shown in Fig. 3, which is a photograph of a pinion which broke in service, and in the side view it is seen that the lower half of the teeth have been battered over by the loose piece jamming between the gear and pinion. It is the upper half of the teeth which is cracked, however, showing that these cracks were not caused by the jamming of the loose piece, but by the gradual hammering of the pinion against the gear in service. It will be noticed that points *a b c d e* gave away successively until at last the loose piece was caught and ripped out, and we find that this is typical of all the failures. The break ordinarily starts at the inner face of the pinion, due to the natural tendency of the armature to cock that way, but in some cases it starts at the outside, probably caused by running a new pinion with a gear which had previously worn taper.

Furthermore the breakages cannot be attributed to so-called crystallization or "gradual fracture," for in many instances the teeth are practically new, having broken after an inconsiderable mileage.

The necessity of having a high ratio between the theoretical working stress and the elastic limit thus becomes evident and justifies us in the adoption of the special means we have described to overcome the abnormal failures.

The lack of alinement of gear and pinion above mentioned is probably one of the chief causes which necessitated the use of these special means, and we have therefore endeavored to find some other method of overcoming the difficulty. This led to the suggestion that as we are actually obtaining only a short bearing on the tooth it would be better to assure this bearing being at the center of the face rather than at the end, which might be accomplished by the use of a tooth something as shown in Fig. 6, in which the central portion is left the standard outline and the balance tapered off both ways toward the ends. No investigation has been made as to the practicability of cutting such a tooth or of its desirability, and it is suggested for consideration merely as one possible way of compensating for the lack of alinement occurring in railway motor gearing.

THE MANUFACTURE, ERECTION AND DEMOLITION OF FORMS FOR CONCRETE WORK.

By FRANCIS W. WILSON.*

For the reason that wood is the cheapest and most adaptable material for making up the necessary forms and supports for reinforced-concrete work, it has come about naturally that this important branch of the work has been left for carpenters to execute. The trade of carpentry is apparently as old as our history of civilization, and it is not to be wondered at that any operation involving the working of wood should be turned over to it, and yet without reflecting on either the skill or the ingenuity of carpenters, the writer considers that this has been a great mistake in many ways.

It is not a part of the ordinary carpenter's training to learn to *design* structures, either as to their strength or with a view to economy. Carpenters, furthermore, have generally been accustomed to building structures which were intended to be more or less permanent, and it is a new field of work which demands a construction of wood which shall be strong enough to support heavy loads for a short time and yet which may easily be taken town and re-erected with the minimum of damage to the lumber. A carpenter in working on a frame house nails everything together securely with the idea that it is to be as rigid and enduring as possible. He would think it very strange if the owner of the house should want him to use as few nails as possible, and yet in form work for concrete the ideal design would be that which could be erected in a stable manner without the use of any nails, excepting the nails required in the manufacture of the various parts of the forms.

The usual procedure when reinforced-concrete work is to be commenced is to order a quantity of lumber supposed to be sufficient for the forms, centering, shoring, etc., and then proceed to "pick up" a force of carpenters, who, under the direction of one or more foremen, are set to work to manufacture the forms, etc., and to erect and remove them as may be required. The only plans usually provided are the plans showing the concrete construction, and the carpenter foreman is left to design his work to conform to the requirements as best he can. It is not strange under these conditions that numerous and costly mistakes are made. Every dimension and every connection must be studied out as the work proceeds, and in the case of complicated work, such as domes, gable window framing, etc., it certainly speaks well for the intelligence of the trade that such work can be executed in any reasonable length of time and without enormous expense. Done as it is, there is an immense waste of lumber, time, and labor, even on the plainest and most simple types of concrete construction.

There are not many engineers who realize today that these conditions had their exact parallel in the building of iron bridges many years ago, and yet such is the case. The custom was

Fig. 5. Suggested Form of Tooth for Subway Motor Pinion.

many years ago during the early construction of iron bridges, in some instances at least, to order the iron, and have it shipped to the site of the proposed bridge, and then the contract for making it up and erecting it was given generally to a boiler maker. The bridges were of the riveted lattice type, and the angles and plates were simply ordered a few inches longer than actually required and cut off to the exact length needed when the bridge was "framed" on the site.

In this we surely have a parallel for the methods now generally used for the manufacture and erection of form work. Such a system of building bridges would be amusing if undertaken today, even for the smallest of truss bridges. It is doubtful, however, if such a method applied to bridge building to-day would result in a greater proportional loss of money than the usual system, as above referred to, for making and erecting falsework for concrete.

The remedy lies along the same lines on which the building of bridges has developed, and that, stated briefly, is to have the designing done in the office. The artisan, whether he be a worker in metal, or wood, has enough to do to execute his work properly, when only the mechanical operations of his trade are left to him, and it is surely asking a great deal to expect that he can also supply the functions of designer, draftsman, and inventor. If reinforced-concrete work is to continue to grow and assume its place as a permanent type of building construction, then the matter of form work must receive more attention from engineers. There should be detailed drawings prepared for the forms, centering, shoring and bracing, showing each part clearly with its exact dimensions, and plainly indicating all work to be done on it. These drawings should be made similar to shop drawings for structural steel work, and to cooperate with them a complete erection plan, or plans, should be provided. With the work detailed in this manner it is not necessary that the forms, etc., should be made at the site of the work. The detail drawings can be sent out for bids, to mills, or to the large wood-working shops, and prices obtained on all material made up complete, and ready for erection, and marked to correspond with the erection plan.

Mills and wood-working shops equipped with modern tools and appliances can execute such work for a mere fraction of the expense incurred if the work is done at the site of the building, by a "picked-up" gang of carpenters. I make this statement in positive terms because I have had experience with both methods a number of times, and the result of having the work done at a mill is that the forms, etc., invariably cost much less after adding the cost of erecting, handling, etc., than the cheapest job done in the field.

Generally when the forms are made up at the site in the usual manner there is almost no salvage value for the lumber after the work is completed. In some cases it cannot even be given away, and teams must be employed to haul it off the site of the work. This wholesale destruction of lumber is due very largely to the fact that it is nailed together so securely during the erection that it has to be pried off the finished concrete with the aid of "pinch bars" and sledge hammers. In the case of the work on which the writer has made detailed drawings of the form work and had it manufactured in wood-working shops or mills, the salvage value of the lumber when the work has been completed has ranged from $10 to $15 per thousand feet B. M. of the total amount of lumber purchased for the work. This in itself is an item of considerable size on any very large job, and would amply justify the methods herein suggested, even if there were nothing else in its favor. There are, however, many other considerations which commend the scheme of designing and detailing the forms and having them made up in mills, and not the least of these considerations is that by so doing the forms can be designed in such a manner that those parts which should be removed first can be taken down without in any way disturbing the remaining portions. A few years ago it was a common thing to find a foreman removing all the centering and supports in one operation, and with the persuasive power of heavy sledge hammers. Removing the falsework in this manner usually took place after the concrete had been in place for a certain number of days, and there was not the least opportunity to examine the condition of the concrete before the forms came down. It was purely a "trust-to-luck" method, and if the work "stood up," it was good work, and if it came down, it was not. It certainly is a good recommendation for reinforced concrete as a building material that there have been so few accidents when we consider the methods which have been used in handling the falsework and, for that matter, which are still used in too many cases. There are a great many builders and general contractors in the country who are just beginning to realize that reinforced concrete has "come to stay," and once they begin to admit this, they are anxious to build some work in this line, and as each of them must have a "first job" in this line, the result will be that for a long time to come we will have important work of this kind entrusted to contractors who are absolutely unfamiliar with it. If these novices could be made to realize that concrete work can be put up with almost no risk of accidents if the falsework is properly designed, and properly handled in the field, it would save a considerable amount of worry, not only on the part of such contractors, but for the owners and architects as well. Yet there is no doubt that such is the case, and a large number of the more experienced contractors in concrete construction are thoroughly posted on this very important feature of the work. Briefly stated, these results as to safety can be attained if the centering, forms, shoring,

*Consulting Engineer, Boston, Mass.

bracing, etc., are designed so that they can be removed in the following order:

First—The column forms.

Second—The sides of girder boxes.

Third—The centering for slabs, excepting over one line of shores. Also all shoring and bracing under the slab, except one line of shores as stated.

Fourth—Loosen the wedges under the remaining shores, and after examining the concrete, if found in good condition, remove all shoring and bracing which may remain.

It should be understood that between each of these operations an interval of two or three days should elapse. For example: In good warm weather the column forms can generally be removed in about five days after they have been concreted, provided that the sample cubes indicate that the concrete has attained a reasonable degree of hardness. After removing two sides of one column box the concrete can be examined, and if it appears too green, the removal of the others of the same age may be postponed. But if the appearance indicates that it is ageing properly all the remaining columns of the same age may be stripped. It must be understood that when this is done, there must be no weight on any of the columns, except their own dead weight.

All the weight of the girders and the slabs is being carried directly by the shoring. The sides of the girder boxes can be removed in from two to three days later, and if a small force is used in removing the forms, as should always be the case, the same gang can generally go on with removing the girder sides as soon as they have stripped the columns. The bottoms of the girder forms are left in place, together with all supports under same, so that there is still no load being put on the green concrete. We have so far only exposed the columns and the sides of the girders to the air, and in this way assisted them to harden more rapidly. As fast as the forms are removed the concrete should be inspected, and if any defective work is found there is an opportunity to remedy it, while the work is still thoroughly supported, and before it is trusted with supporting its own weight.

In carrying out the third operation, if the slab spans are short, as for example under 7 ft. long, then it is generally safe to remove all the slab centering and all the shoring and bracing under same at one operation, but even in this case the first thing to be done is to loosen up the wedges, after having examined the appearance of the top of the slab, and being assured that the concrete is in good condition so far as surface indications are concerned. If the slab spans are of any considerable length, it is better to have one line of supports so arranged that they bear directly on one board, and this board being at, or near, the middle of the span of the slab, the remaining slab centering and supports can be removed without disturbing the line of shores supporting the single board at the middle of span. This gives an opportunity to inspect the under side of the concrete slab, and if there are any imperfections in the work they can then be remedied, before the slab is trusted with any loads. If it is found in good condition, then it is best to leave it exposed to the air for a few days before finally loosening up the wedges under the line of shoring which still remains in place, and removing them. If this method is followed there is not the slightest danger of having accidents on the work. But it is not possible to have any such program carried out if the forms are all nailed together as they usually are during the erection of the work, and to remove one part of the falsework without disturbing the remainder is out of the question.

It is not to be expected that carpenters without any plans, except the plans of the concrete work, can design the forms in the field so as to meet these conditions; it is a class of work which should be studied out by engineers who have had an extensive experience in the field in close contact with concrete construction work. As to the particular way in which the forms are designed to meet these conditions, it is not essential to follow any one scheme, so long as the design is worked out with the idea in view that the parts may be readily removed in sequence, along the lines already indicated, and this can be done by using a fair amount of ingenuity, and by depending on the use of iron and wood clamps instead of nails for connecting the parts together. Of course it is not intended that the reader shall get the impression that no nails are to be used in the manufacture of the work.

The sides of girders, sides of column boxes, and the bottoms of girder boxes should be made up complete in the mill, and these should be thoroughly battened, and the boards comprising same should be thoroughly joined together by means of the battens nailed to them. Any parts which can be readily handled in the field should be made up complete in the mill and these should be securely nailed together. But it is in the field work that nailing should be avoided, and dependence placed on the use of clamps and interlocking devices which can be so well studied out in preparing the design that no nailing of any consequence will be necessary in erecting the forms. There are so many variations of these details possible that there is little use to suggest any details of this kind, as it is better to study out the requirements of each individual case as it arises. It is not even recommended that any attempt be made to standardize the details of form work beyond a certain point, as this does not give the good results to be obtained by a special study of each job and its particular requirements.

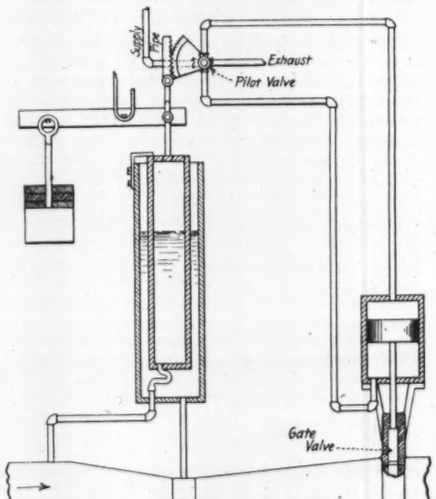


Fig. 1. Automatic Discharge Regulator, Using Venturi Meter Principle.
(F. N. Connet, Providence, R. I., Inventor.)

There is one other consideration which alone brings the designing of form work strictly within the province of the engineer, and that is that there is no other way by which it is possible to know in advance just what the falsework will cost on any particular piece of work. If this remains an unknown quantity, how is an architect or engineer to say that the design he has worked out for a structure is economical or otherwise?

The cost of the falsework is such a large and important item in the whole cost of the work, that if it remains a matter of guess work, as it usually does, it is simply impossible for the engineer to say whether or not some other arrangement of the columns, girders, etc., would not result in saving a great amount of money in the first cost of the work.

Where the falsework is manufactured at the site of the work there are often found layers of sawdust, chips, and sometimes blocks of wood, in the concrete, and especially in the columns. This source of danger is practically eliminated when the forms are not manufactured at the site of the work.

There is another condition which generally exists when the contractor for concrete work picks up a force of carpenters in the vici[illegible] of the job and puts them to work to m[illegible] up the forms, and that is, that the contractor[illegible] goes into a district where he does not kn[illegible] local labor conditions, usually gets the [illegible] of the carpenter trade in that locality. [illegible] local builders know the men who are worth[illegible] their trade, and a contractor coming in [illegible] elsewhere does not. The result is that h[illegible] rally gets the carpenters that cannot get [illegible] ment from any one who knows them. And [illegible] men are to be found in every district.

AUTOMATIC DEVICES FOR MEASURING WA[illegible] USED FOR IRRIGATION.

By F. W. HANNA.*

One of the most important feature[illegible] the great question of conservation of the [illegible]tural resources of our country is the extensi[illegible] of the possibilities of irrigation. The limit of [illegible] reclaimable land in the arid regions is no[illegible] determined by the extent of arable land but [illegible] by the quantity of water available for the [illegible] thereof. The future of irrigation growth therefore depends on the economic and beneficial use of water. All of the arid states recognize the soundness of the doctrine of beneficial and economical use of water as the fundamental basis of the right of its use for irrigation, and many of them have incorporated in their irrigation codes this doctrine together with the equally important principle of appurtenancy and inseparability of the water right and the land irrigated. The economical use of water for irrigation can only be obtained by charging for the amount of water delivered at the irrigator's headgate. Such a basis for water charge involves the difficulty, therefore, of making accurate measurements of the water delivered. Many attempts have been made to devise satisfactory methods of handling the problem and it is the aim of this discussion to summarize the methods most generally in use and some of the most worthy American devices invented for the purpose.

In Italy, where irrigation is many centuries old and where irrigators have long been accustomed to pay for water by volume, the measurement of water has reached a fairly high standard of excellence. So far as the writer was able to gather from inquiry and inspection while in the irrigated districts of northern Italy there are two general methods of measurement employed, that of Soldati involving the use of the orifice and that of Cippoletti involving the use of the weir. In Soldati's method the water to be measured is taken out of the supply canal through headgates into a short masonry channel at the lower end of which is an orifice of appropriate dimensions opening into the distributing ditch. The head on the orifice is regulated by means of setting the headgates at the proper opening to maintain a constant discharge. The masonry channel between the headgates and the orifice is made of sufficient length to prevent the disturbance of water gained in passing the headgates from reaching the orifice. The water master in making his rounds sets and locks the headgates at such an opening as will give the required head on the orifice. If the water surface in the supply canal were constant this method would be satisfactory, but, inasmuch as it is constantly subject to fluctuations, the discharge through the orifice is likewise affected. Considerable difficulty is also experienced from the fact that the supply canal is not always purposely operated at the same discharge, thus making it difficult to determine the elevation at which the orifice should be placed for producing the best results. The Cippoletti method consists of the use of the well known weir bearing the inventor's name in conjunction with a measuring box connecting the weir with the headgates at the supply canal. The head on the weir is controlled by regulation of the headgates as in the case of Soldati's orifice. It will be seen, therefore, that this method has about the same merits and is subject to about the same troubles as is the orifice method.

*Engineer, U. S. Reclamation Service, Washington, D. C.

In India and Egypt the assessments for the use of irrigation water are generally based on the area irrigated. The authorities in charge of irrigation works believe that the degree of intelligence and honesty of the water users in these countries is not adequate to permit of assessment by volume. In carrying out the plan of assessment by irrigated areas each canal and its several subsidiary branches are designed with capacities at full discharge proportional to the areas to be served, the laterals receiving their

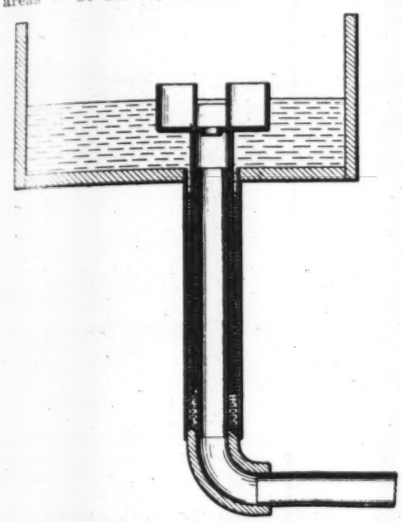


Fig. 2. Regulating Weir, Flotation Type.
(W. S. Post, Los Angeles, Cal., Inventor.)

supply from the main canals through headgates of sufficient size to discharge the proper amount of water. The system is defective when the canal for any reason is operating at less than full capacity as proportional discharges will not be taken by the subsidiary canals; and the natural silting and scouring of channels, deterioration of structures and the interference of interested irrigators all serve to break up the efficiency of distribution. Constant and elaborate investigations are necessary to ascertain whether defects in equitable distribution are growing; and lack of adequate supervision and repairs results in gross inequalities of distribution of the water. Moreover, when it is found that an improper distribution is being made on any branch of the system, it becomes necessary to correct the existing evil by cleaning or enlarging its channels or in many cases by the reconstruction of its headworks. Such a system besides being difficult to maintain and unjust to the irrigators is wasteful in the use of water. The irrigators have no interest in the amount of water used and are, therefore, prodigal in its use. Opportunity for dishonesty in the supervising force is always present and is almost certain to result in grievances to irrigators and wasteful use of water. These facts are all well recognized by the engineers in charge of Indian and Egyptian irrigation works and attempts are at present being made to devise methods of automatically regulating and measuring the water delivered to irrigators. The Indian Irrigation Commission of 1901-3 in its report recommends that continuous and strenuous efforts be made to perfect the system of distribution by the use of modules and by other means. "Punjab Irrigation Paper, No. 12," by R. G. Kennedy, on the distribution of water for irrigation by measurement, describes some interesting devices for measuring irrigation water that are being experimented with on Indian irrigation systems.

In the early development of irrigation in the United States very little attention was paid to the measurement of water delivered to the irrigators. Under these earlier developments the water supply was usually abundant and there was no need of economy in its use. As more appropriations have from time to time been made from the rivers, the water supply has gradually become more limited until in many sections of the arid regions it is insufficient to water the lands now under irrigation, much less to develop new irrigation projects, and especially so without the construction of storage reservoirs. The expense involved in the construction of such reservoirs and the general scarcity of water have led irrigators fully to realize the necessity for economical use of irrigation water. There are, however, many canal systems still in existence where the charge is based on the area irrigated, on the volume used without definite measurement or on a definite proportion of the flow of the canal regardless of volume. Many of the irrigation companies that have in the past delivered water to farmers without measurement are now putting in measuring devices and charging for the use of water by volume. Some irrigation companies base their charges for water on a combined consideration of the area served and the volume used.

Practically all of the earlier measuring devices used for measuring water for irrigation were designed for determining the quantity in miner's inches, and many of these devices are still in use. One of the most successful is the well-known excess weir invented by Mr. A. D. Foote, of Idaho. The definitions given to a miner's inch in the various states require the measurement of the water through an orifice; but attention is usually given to conditions other than the head affecting the discharge. Recent legislation and efforts of engineers have resulted in the adoption of weirs of the Francis or Cippoletti type. In most cases, however, where measurements are made the conditions for accurate measurements are not good. The weirs or orifices are placed adjacent to the takeouts or at such short distances therefrom as to leave the discharges subject to the influences of disturbances at headgates. In other cases even where fair conditions for accurate measurements exist, infrequent adjustments of the headgates and lack of close inspection and supervision result in unknown deliveries of water. In some localities a rating flume is used for obtaining the discharge. In this method the flow is obtained from a discharge-gage curve established from current meter measurements. Much improvement in the distribution of water could be obtained by the adoption of either of the Italian methods of measurement hereinbefore mentioned, but even then ideal conditions would be far from realization. Ideal distribution requires a mechanism that will not only automatically measure the water delivered to the irrigator, but that will at the same time automatically regulate the delivery to a constant amount, varied from time to time to suit the conditions. The chief obstacles to the solution of the problem are excessive cost of the meter, inability of the meter to measure water containing debris and the requirement of head for operation of the meter. The obstacles eliminate the use of the ordinary house meter or even an adaptation of the current meter from consideration. A number of ingenious automatic modules that will measure a variable delivery of irrigation water and a few automatic constant discharge modules that will simultaneously regulate and measure a constant discharge of water have been invented.

The automatic modules are useful in performing the function of measurement, but their use falls short of the full solution of the problem as the matter of regulation is generally but little less important in irrigation than the measurement. The "Australian Irrigation Ditch Water Meter" described in Engineering News for March 26, 1908, is probably a good illustration of this type of module, and its practical success is there discussed. No statement, however, as to its workings in debris-laden water is made and this it would seem might be one of its most serious defects. Automatic gage height recorders have been used in connection with weirs and orifices for measuring a variable discharge. In using this method of measuring discharge the average head acting on the weir or orifice is obtained by taking a mean of the indicated head from the gage height recorder diagram. Inasmuch as the discharge computed for any period from the mean head is not equal to the discharge actually obtaining at the variable head for the period, the method is unsatisfactory. The process of obtaining the mean head is, moreover, not an easy one as it requires the tracing of the diagram with a planimeter or some still more laborious method.

Of the devices invented for solving the complete problem of simultaneous regulation and measurement, there is a considerable number, and they may be divided into two important classes, those requiring external power for operation and those operating automatically through the action of the canal water.

One of the most ingenious and recent of the class requiring external power for operation is the invention of Mr. F. N. Connet, of Providence, R. I. In this device, shown in Fig. 1, an outlet pipe in the form of a Venturi meter is used and the controlling gate is placed in the enlarged section of the pipe beyond the throat and is operated by hydraulic pressure from an external source, the water under pressure being admitted from this source to the upper or to the lower surface of a piston attached to the controlling gate. The admission of the water to the proper surface of the piston is controlled with a pilot valve operated by means of a primary receptacle attached to it and suspended in a secondary receptacle connected wtih the throat of the outlet pipe, the primary receptacle being flexibly connected with the enlarged section of the discharge pipe on the supply side of the throat. When the discharge for which the mechanism is properly adjusted is occurring, equal pressures of water are admitted to the top and to the bottom of the piston. If the velocity of the water through the discharge pipe is in-

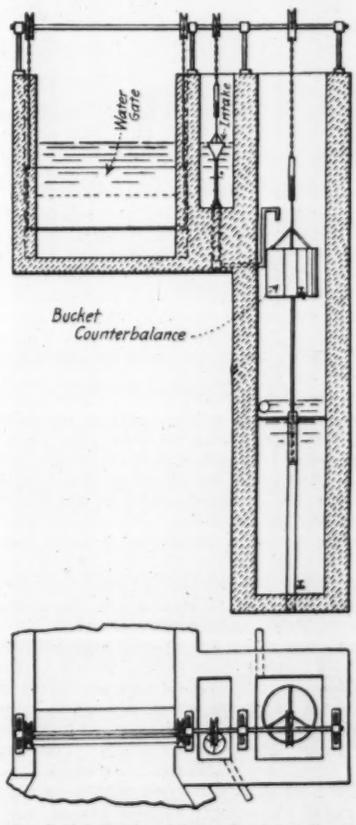


Fig. 3. Self-Adjusting Water Gate for Constant Discharge.
(F. W. Hanna, Washington, D. C., Inventor.)

creased, the water in the secondary receptacle falls a greater amount than that in the primary receptacle, due to a greater decrease in the pressure in the throat than in the enlarged section of the discharge pipe. The primary receptacle therefore descends, opens the attached pilot valve and admits water to the top of the cylinder, thereby closing the gate slightly and decreasing the discharge. If the discharge de-

creases, the primary receptacle rises, opens the pilot valve and admits water to the under side of the piston, causing the gate to open slightly thereby increasing the discharge. It is evident that other mechanisms for regulating and measuring the flow of water might readily be devised by the use of electrical, hydraulic or other kinds of energy from external sources, but such energy is not usually economically available for the purpose.

The devices designed to regulate and measure the discharge of irrigation water from supply canals automatically through the action of the water cushion for retarding accelerated motion of the operating mechanism due to the excess of starting over moving friction. The gate, intake and bucket are connected to their sheaves in such a manner that the gate and intake act oppositely from the bucket in producing rotation of the shaft. With the operating system in equilibrium, the common water surface in the main canal and intake chamber is slightly above the top of the intake, and a constant small amount of water entering the intake flows through the connecting pipes, the bucket and the adjustable outlet at the bottom thereof. If

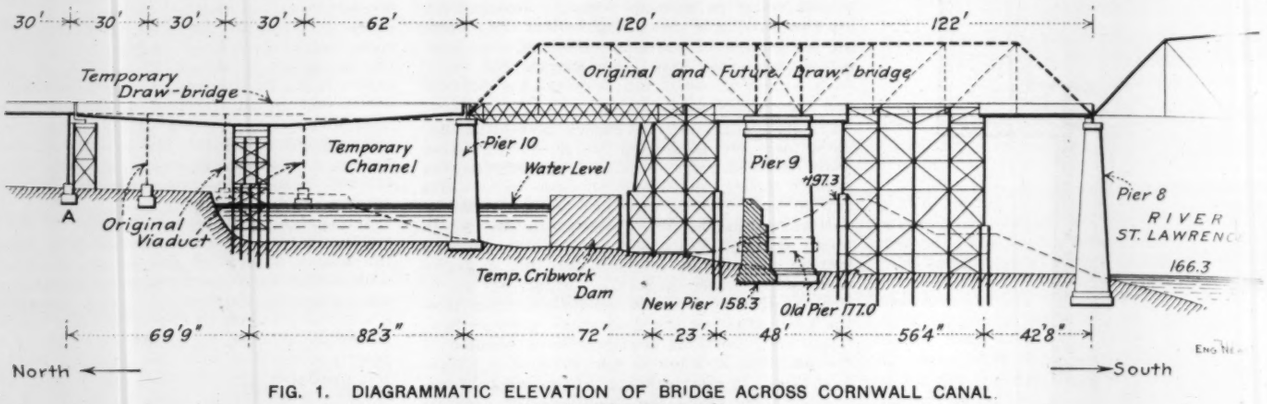


FIG. 1. DIAGRAMMATIC ELEVATION OF BRIDGE ACROSS CORNWALL CANAL.
Showing old and new work.
(Elevations are from railway datum.)

canal water consist of what might be called the flotation and the gravity types. These two types of automatic constant discharge regulators aim at the complete solution of the irrigation water measuring problem.

Of the flotation type, the recent invention of Mr. W. S. Post, of Los Angeles, Cal., may be mentioned as being representative. His invention (Fig. 2) consists of a weir supported by floats in the supply canal and fitted at the bottom to a discharge pipe connected by a special joint with another discharge pipe leading to the takeout canal. The upper portion of the discharge pipe leading to the takeout canal consists of two concentric cylinders joined at their lower ends and the weir discharge pipe slides between these two cylinders. In this manner a partial water seal is obtained preventing an excessive outflow of water except over the weir. One side of the weir box serves as a measuring weir and the water passes over this weir into the box, thence through the discharge pipes into the takeout canal. The quantity of water flowing over the weir is kept constant by means of the floats maintaining its crest at a fixed distance below the water surface of the supply canal. The other inventions of this type differ from the one described mainly in the method of connecting the discharge outlet of the weir box with the discharge outlet leading to the takeout canal.

The writer has recently invented a mechanism for automatically measuring and regulating irrigation water that belongs to what has been hereinbefore styled the gravity type for want of a better name. This device, shown in Fig. 3, regulates the flow from the supply to the delivery canal by means of an automatic, constant discharge, movable water gate, producing in effect either a weir or an orifice. This gate is hung from chains attached to sheaves keyed to a horizontal shaft above the surface of the supply canal. The shaft extends beyond the gate at one end and is provided with another sheave and chain from which is hung a bucket which can contain enough water to counterbalance or raise the gate. Water is admitted to the bucket through an intake suspended by a chain and sheave from the horizontal shaft at an adjustable height above the discharge edge of the gate. The intake communicates with the bucket through a system of telescoping pipes. An adjustable outlet is provided in the bottom of the bucket.

The bucket is provided with an adjustable

the water surface in the main canal rises, a larger amount of water will enter the intake than can be discharged through the outlet of the bucket, thus increasing the weight of the contents of the bucket and causing the gate and intake to rise until the excess flow is stopped and equilibrium established. On the other hand, if the water surface in the main canal falls, the flow into the intake will diminish and the discharge from the bucket outlet will decrease the weight of the contents of the bucket, thus permitting the gate and intake to descend of their own weight until the increasing flow into the intake again establishes equilibrium. Where the drop in the water surface is insufficient to supply the operating head, the bucket can be installed in a water-tight well from which the water may be removed periodically by means of a small hand pump or continuously by means of any suitable mechanically operated device.

THE TEMPORARY BRIDGE ACROSS THE CORNWALL CANAL AND THE PERMANANT REPAIRS TO THE CANAL BREAK.*

When the river bank of the Cornwall Canal at Cornwall, Ont., broke through on June 23 last, carrying with it the draw pier and part of the bridge of the New York & Ottawa Ry., the first efforts of the engineers on the work were directed toward putting the canal in shape to carry the large grain traffic then passing down the river. The reconstruction of the bridge, which carried a very small train service, had to wait. The repairs to the canal, described together with the history of the break, in our issue of July 9, 1908, p. 34, were completed with remarkable speed and efficiency on July 10, just 17 days after the accident, and immediately thereafter the construction of a temporary crossing for the railway was commenced. On account of the inaccessibility of the site, with the main bridge disabled, the unreliability of the foundation ground, the necessity for immediate reconstruction and the congested condition of the right-of-way, the erection of the temporary structure presents many interesting features.

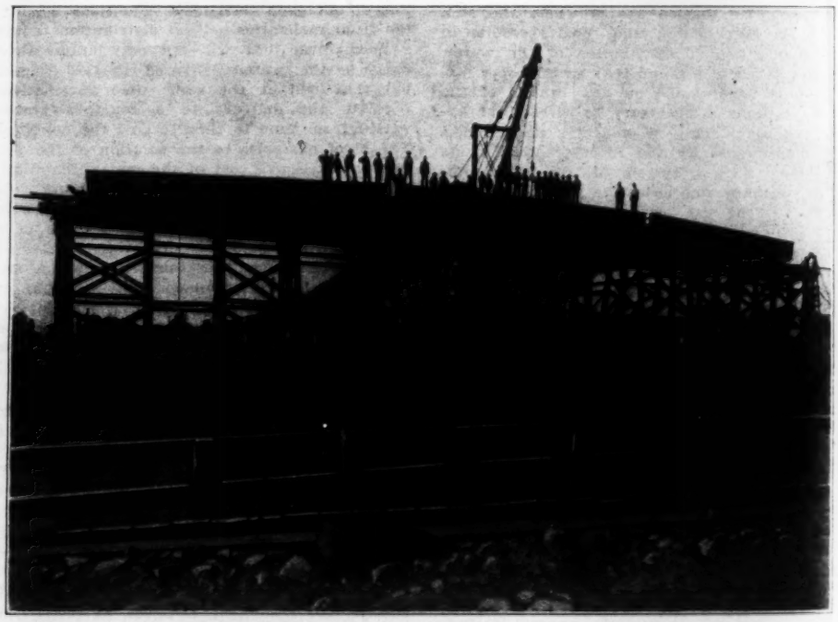


FIG. 2. VIEW SHOWING TEMPORARY DRAW BRIDGE IN COURSE OF ERECTION.

The New York & Ottawa Ry., now a subsidiary line of the New York Central & Hudson River R. R. Co., crosses the River St. Lawrence at this point on a series of large trusses and,

*Railway datum zero in the drawings equals government datum zero + 140.5 ft. All elevations except in Fig. 6 are given from railway datum.

up to [illegible] time of the accident of last June, crossed [illegible] canal, which is immediately north of the no[illegible] bank of the river, on a steel viaduct and sw[illegible] draw, shown in dotted lines on the cut in F[illegible] 1. The washout in the canal undermined [illegible] central pier carrying the drawbridge and th[illegible] that entire structure into the canal bed. A[illegible]nd the debris the canal engineers built a timb[illegible]tone-filled crib which acted as a dam to sto[illegible]e hole in the bank and, by dredging north [illegible]he original canal line, formed a curved channel around the break. This dredging necessitated the removal of the steel viaduct back as far as the bent marked A on Fig. 1. The work for the bridge engineers, therefore, consisted in building a single-track crossing from bent A to Pier No. 8, the north pier of the large cantilever crossing the St. Lawrence, a total construction of 394 ft., in which a drawbridge over the canal was required.

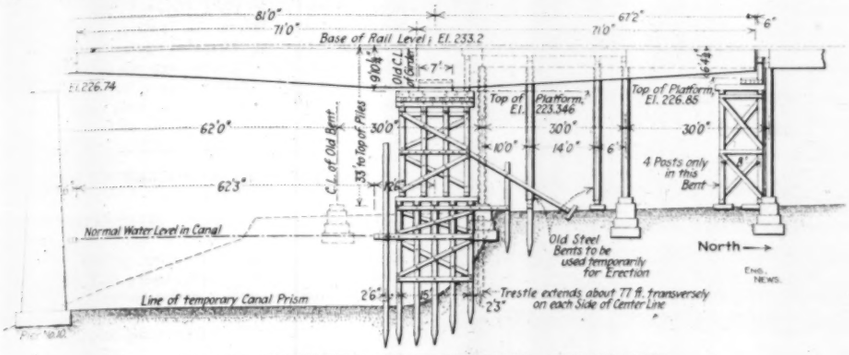

Base of Rail Level; El. 233.2
El. 226.74
Top of Platform, El. 223.346
Top of Platform, El. 226.85
4 Posts only in this Bent
C.L. of Old Bent
33' to Top of Piles
Normal Water Level in Canal
Old Steel Bents to be used temporarily for Erection
North
Line of temporary Canal Prism
Trestle extends about 77 ft. transversely on each Side of Center Line
ENG. NEWS.

FIG. 3. ELEVATION OF TEMPORARY DRAWBRIDGE.
(Elevations are from railway datum.)

The temporary structure, which is now in service, is shown in heavy lines in the cut in Fig. 1 and in completed form in the view in Fig. 4. Starting from the cantilever it consists of a 42-ft. plate girder, a 56-ft. timber trestle, a 48-ft. plate girder, a 23-ft. timber trestle, a 72-ft. lattice girder and finally a 152-ft. plate-girder swing drawbridge, resting on a timber bent center support. All of this steel work came from the various store yards of the railway and was material that had been in use on other branches of the road, but which had been superseded. None of it was in exact size or strength to be placed immediately in the temporary structure and considerable shop work was necessary on each section.

The work from the north end of the cantilever to the crib work was comparatively simple, consisting merely in driving timber piles in the bottom washed clear by the rush of water from the canal break. The greatest difficulty here was in removing the steel of the wrecked drawbridge which lay in a twisted mass just where the timber bents were to go. Up to the north timber base of the second plate-girder the bents were set upon pile footings, but north of this point the proximity of the timber crib, which held the canal water, prohibited the use of piles on account of the possible loosening of the earth and the consequent leakage through or under the crib. So these bents were set on mud-sills. From this bent to the old stone pier No. 10, which remained after the break, a lattice girder was extended. This completed the work on the south side of the canal for which the material could be brought from the States directly, across the St. Lawrence bridge. The erection of the drawbridge, by far the most difficult part of the reconstruction, had to be executed on the north side of the canal and all material brought up from headquarters by some roundabout way through Canada down again to Cornwall. During the entire erection heavy traffic, for which provision had to be made, was passing through the canal.

At first it was intended to build this drawbridge using old pier No. 10 as a center pier, extending its carrying surface by driving piles on all sides of it, but the slenderness of the pier and its not altogether assured stability owing to the adjacent temporary canal excavation induced the engineers to change the design to the one adopted. In this scheme the heavy framework shown in Fig. 3 was erected on piles driven in the new canal bottom and the bridge, resting on this framework swung between one of the steel trestle bents on the north and pier No. 10 on the south

The drawbridge is shown in Fig. 3. In its original location on another part of the New York Central Lines it was a through double-girder, double-track, center-bearing swing span 142 ft. long. Some time ago it had been removed and the opening filled by another bridge and at the time of the collapse it was in one of the store yards of the railway. To utilize it for the Cornwall span it had to be changed in many ways. In the first place it was made into a deck span, which necessitated the reversing of the girders so as to bring the curved original upper flange into the lower flange. A new system of lattice bracing and a new center cross-girder system had to be placed and as will be noted from Fig. 3, these new lattice panel points do not come opposite the stiffener angles of the girder, as is usual in plate-girder work. The latticing consists now of alternate single diagonals at upper and lower flange and cross struts at both flanges. The original span was 142 ft.; the present span is 148 ft., so that an extra 6 ft. had to be spliced onto one end of each girder to bring it to the correct length. In addition the new center is not in the center of the 148-ft. span, so that counterweight had to be provided at the short end to balance the span.

The new span, as adjusted to its present conditions, is a center-bearing swing draw of the usual type, with the center pintle and circumferential bearing rails resting on timber blocking supported by the trestle. As in the original structure the draw is kept normally open, to provide for which, and for future dismantling, the erection trestle, a structure transverse to the line of bridge, has been left in place. Luckily, in its old location the drawbridge had been hand-driven and had rested on a timber center so that no changes had to be made to meet these same requirements in the new position.

The shop work for the structural changes were all made near New York City and shipped from there to the railway yards at Harmon, N. Y., where the entire bridge was assembled. It was then dismantled, each girder divided into three pieces, and shipped by a roundabout route to the bridge site, where it was erected on the timber work extending parallel to the canal (Fig. 2). The shop work was so arranged as to utilize as much as possible of the rivet holes, shapes, etc., on the old girders, with the result that very little punching and riveting had to be done in the field. Most of the deck and wedge levers and connections were of new material arranged especially for the new service. The plate-girders used in the temporary structure presented no especial difficulty but the long lattice girder was not of exact size required, so the end which rested on the masonry pier had to be cut away and lengthened slightly so that the lower chord had an upward slant to clear the corbel on top of the pier. The plate-girders were in rows of two, 6-ft. on centers, but the lattice girders were in two rows of two pairs, each 1 ft. 6 ins. on center and the rows 5 ft. apart.

In addition to the work heretofore described the railway had to build heavy fenders to protect the piers because the enforced turn in the new channel makes the handling of a boat more uncertain and the protection of the timber and masonry piers in the canal a matter of necessary precaution.

As noted in the first part of the article the canal break occurred June 23. On July 10 the water was let into the canal and on July 16 the first canal boat went through the damaged section. Up to this time the engineers of the railway had not been able to do any construction work, but were preparing drawings, beginning shopwork and searching for material. On July 15 the first pile for the temporary construction was driven; on Aug. 2 the southern portion of the trestle was practically completed and on Aug. 17 the first train passed over the finished structure (Fig. 4). The work was carried out under the direction of the railway engineers by their own workmen.

PERMANENT RECONSTRUCTION. — The present temporary repairs to both canal and bridge will remain in service until the cold weather shuts down all traffic on the canal, but meanwhile plans for permanent structures here have been made and the start made on the new work. As soon as the concrete retaining wall is completed across the break the work of removing the temporary dam will be commenced. It is proposed to remove the stone filling, ties and back timbers down to about 10 ft. below level of water in canal (bracing the face timbers with their sheet piling against the head of water), lower the water in canal 10 ft. for one day and cut the sheet piling all around, thus

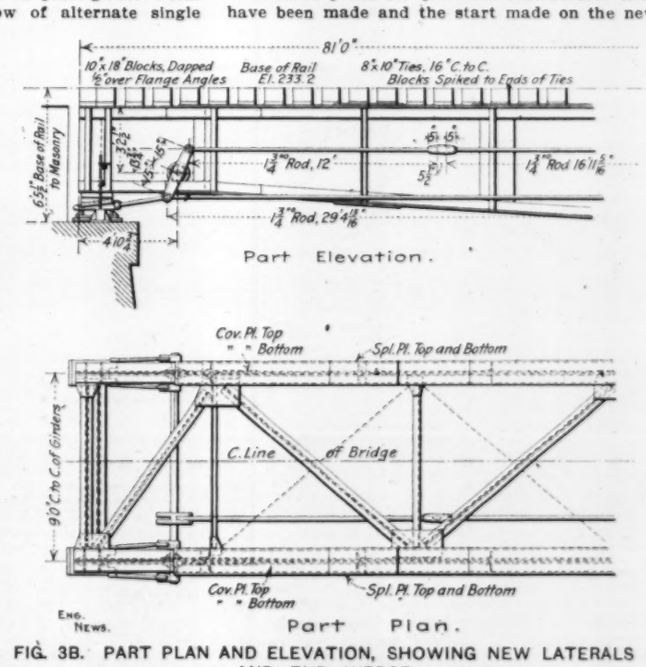

81'0"
10"x18" Blocks, Dapped 1/2" over Flange Angles
Base of Rail El. 233.2
8"x10" Ties, 16" C. to C. Blocks Spiked to Ends of Ties
Base of Rail to Masonry
1 3/4" Rod, 12'
1 3/4" Rod, 16'11 5/16"
1 3/4" Rod, 29'4 13/16"
Part Elevation.
Cov. Pl. Top
" " Bottom
Spl. Pl. Top and Bottom
C. Line of Bridge
9'0" C. to C. of Girders
Cov. Pl. Top
" " Bottom
Spl. Pl. Top and Bottom
ENG. NEWS.
Part Plan.

FIG. 3B. PART PLAN AND ELEVATION, SHOWING NEW LATERALS AND END WEDGE.
(Elevations are from railway datum.)

allowing it to float out when the water is again raised. The balance of the dam will be removed when the canal is unwatered in the spring. The canal cannot be unwatered before April 1, 1909, on account of the manufacturing interests situated near the lower entrance on the same level as the break, which have to be supplied with water power. The long concrete retaining wall connecting with the lock wall below will be constructed during the month of April.

This permanent construction on the bridge comprises a new draw-span resting on a masonry pier at the site of the overturned original center pier and spanning practically the same opening as the first drawbridge, together with the original viaduct that was taken down to make way for the temporary draw. The canal is to be strengthened by the construction on the canal side of the bank of a long concrete retaining wall extending across the present break in the arm and connecting with both the draw pier and the masonry canal lock walls some 500 ft. down the canal. Behind this wall the canal bank will be formed as it was before the break and a heavy stone toe will be built on the river side slope to protect the embankment from floods in the river.

Although the cause of the primary break in the canal is not certain there is no doubt that the original draw pier was founded on weak ground, stratified with soft clay and quicksand. The rushing waters from the break completely undermined the pier and, when it had been thrown aside, tore out the bottom about 15 ft. underneath the original footing. Investigations since the accident have shown that a good bottom can be had about 19 ft. below the canal bottom, that is at elev. 418, as shown on the accompanying drawings. At this elevation, then, the new draw-pier was founded. The design of this pier is shown in Fig. 6. It consists of a circular concrete shaft 23 ft. in diameter surmounting a square section pedestal with offsets of 30 ins. at the bottom. The design is somewhat complicated by the arrangement of the sides of the pier to fit into the section of the retaining wall.

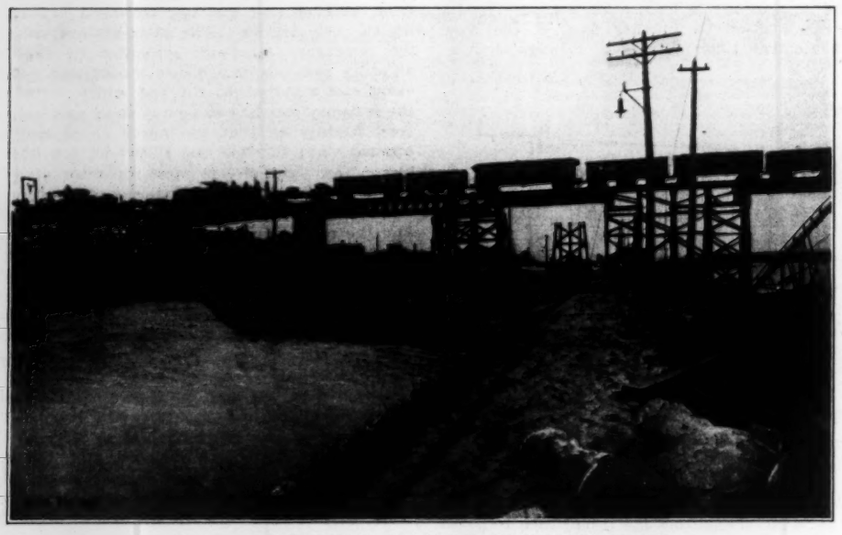


FIG. 4. FIRST TRAIN CROSSING TEMPORARY BRIDGE.

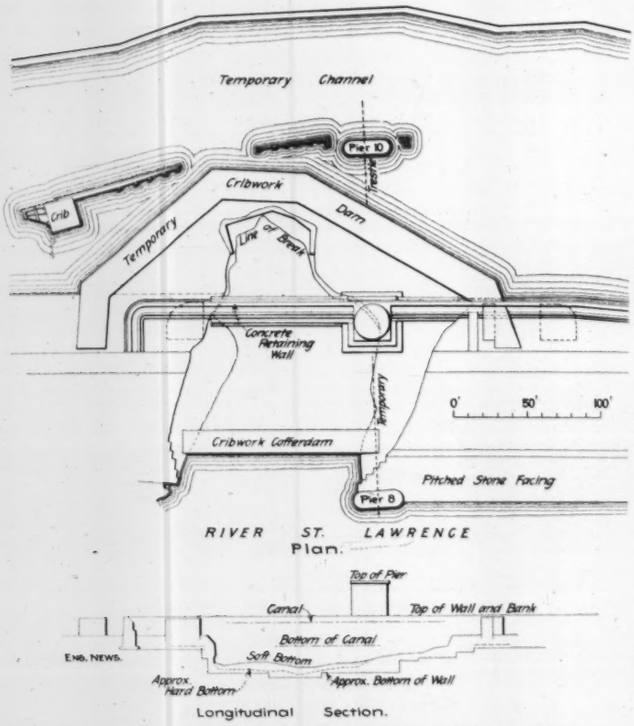


FIG. 5. PLAN AND SECTION OF REPAIR WORK ON THE CANAL BREAK.

Fig. 5 shows the general section through the wall and the pier on a line parallel to the canal. It will be noticed that the elevation of the bottom of the wall varies with the condition of the ground and that the width of the bottom section of the wall increases with the depth of the footing. The wall and the pier are completely separated structurally, but at the joint two 12-in. timbers are inserted as shown to act as stop-logs against possible percolation. In the construction of the pier and that part of the wall across the gap in the bank, a timber crib, filled with stone and covered with canvas on the river side, was thrown across the opening near the river (Fig. 5), and the space pumped dry. At present the pier and wall are completed up to the top of canal bank; and the construction of the upper portion of the pier will be carried to completion at once. The new drawbridge is to be of the through truss swing type, somewhat heavier than the old one, of the same general form and dimensions but with riv... instead of pin connections and equipped wi... ctric as well as hand drive.

The work of reconstruction on the ... is under the direction of Mr. A. W. Carp... Assoc. M. Am. Soc. C. E., Engineer of Stru... N. Y. C. & H. R. R. R., and that on the ... of Mr. C. D. Sargent. M. Can. Soc. C. E., ... nt Engineer of the Ontario-St. Lawrence ... ls. We are indebted to these gentlemen f... Information and cuts here given. The ... Engineer of the New York Central, Mr. ... rge W. Kittredge, and Mr. J. L. Weller, act... for the Canadian Deputy Minister and Chi... gineer of Railway and Canals, are in fina... rge of the design and construction. The co... tor for the construction of the pier and ca... ork is Mr. Thos. A. Nicholson, of St. Cather... Ont.

A PROPOSED SANITARY DISTRICT FOR NORTHERN INDIANA.

With the establishment of great ... works and other large industrial enterprises in Northern Indiana, at Gary and other points along the shore of Lake Michigan, there will be a great development in the population of this district. At a meeting of the Gary Real Estate Board and the Northern Indiana Deep Waterway Convention, held at Gary, Ind., on Nov. 10, an address was delivered by Mr. John W. Alvord, M. Am. Soc. C. E., on the desirability and the necessity of organizing a sanitary district to take care of all questions of water supply and sewage disposal within this territory. From his address we take the following extracts:

The health and well-being of probably a million people, future residents of the little 40-mile strip of northern Indiana that lies along Lake Michigan, will depend largely upon the care and forethought which we give to their sanitary environment. It is to my mind more than a mere achievement of business or brains or engineering. To me it arises into the field of ethical import.

It is usually the case that problems so vast as this require something more than the suggestion of one man or a number of men, brilliant and capable although

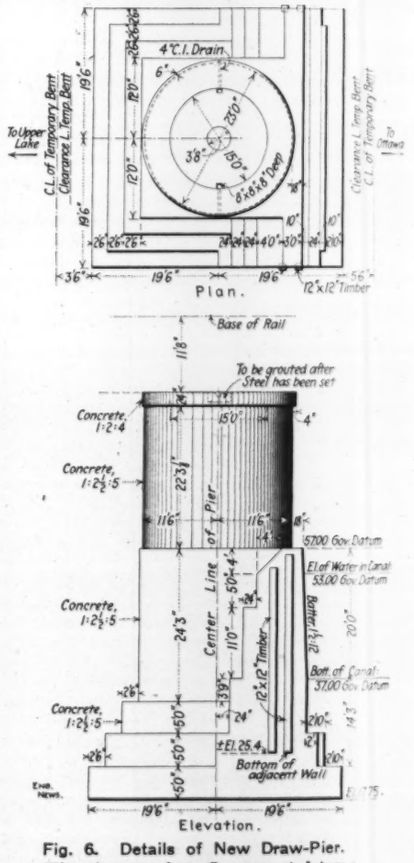


Fig. 6. Details of New Draw-Pier.
(Elevations are from Government datum.)

those suggestions may be. They require, in the first place, proper organization, with the necessary authority, time and means to make a prolonged and careful study of the many problems that are bound to be involved in a minor way in the one great problem as it first appears. Therefore, it seems to me wise to suggest that before we make suggestions for the solution of the problems of water supply, sewerage, and drainage of floods for the southern shore of Lake Michigan, we should begin at the beginning of the problem and carefully consider what should be the best form and arrangement of a selected body of broad-minded men who would undertake, in a conservative and patient way, to unravel this tangle.

We have seen in Chicago, an organization known as the Sanitary District of Chicago, which, backed with the proper legal authority and taxing power, has performed a mighty task. Before we can properly appreciate the problem we, too, shall organize a sanitary district, which I hope, somewhat more wisdom and caution than was displayed when there was organized the Sanitary District of Chicago. With this wisdom we will not undertake beforehand to decide the exact direction of our channels, but shall leave to a wise and careful commission, having the power and the time to carefully study the problem. Such a commission should outline from time to time what may be best for this or that portion of the district, with the certainty that its labors will be based upon exact facts. Such a commission would have the necessary time in which to weigh carefully each suggestion made, and be guided in selection, not only by those who promulgate ideas, but by the general public which must pay for them.

It will therefore be my suggestion that instead of deciding in advance upon any kind of a channel, or any particular method of sewage disposal or water supply, the inhabitants of the lake shore of Indiana, first of all form what may be called the Sanitary District of Indiana. This district ought to comprise all of the lake shore and its tributary watershed between the state lines of Illinois and Michigan. It will have about 40 miles of lake frontage, and a depth at its greatest of about 17 miles, with perhaps an average of 12 miles in width. It will comprise perhaps 550 to 600 sq. miles of territory, draining at the present time into Lake Michigan.

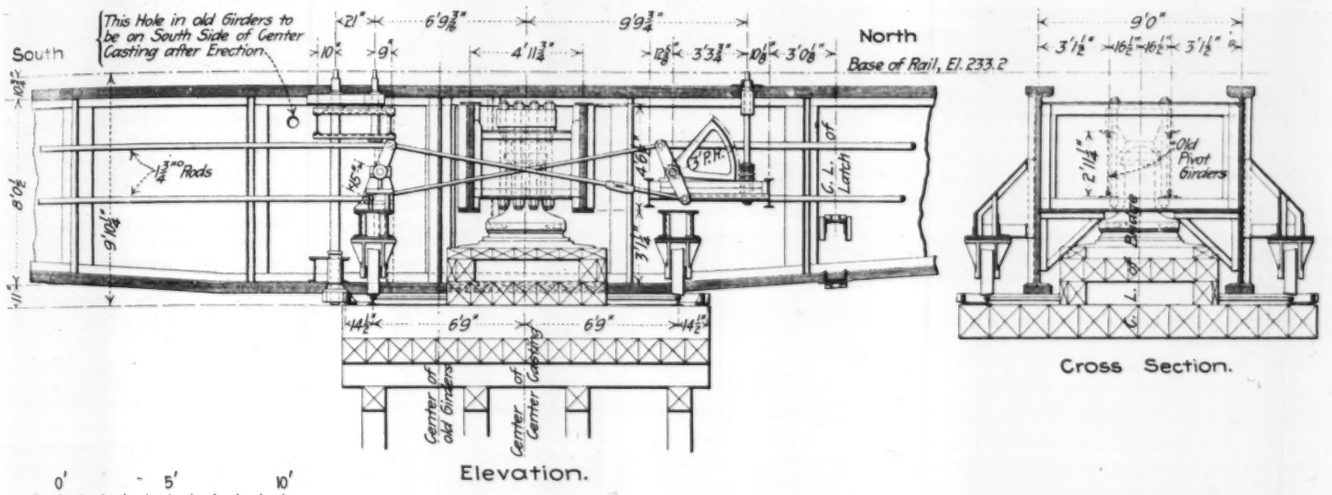
Such an organization should be empowered to employ experts, and provide for surveys, maps, flow measurements of streams, etc., so that it may formulate a general plan of procedure which may be locally applied from time to time to various sections within its borders. It should have general and guiding control of the drainage, sewerage, water supplies, the intakes, the sewerage systems, sewage disposal works, water filtration works, the necessary channels within its borders, and the power to tax and construct or fix and prescribe both locally and generally, rules for the same. All this in order that it may have the full ability not only to study and to originate, but to thoroughly and effectually approve, direct or even carry out to a final conclusion any or all public matters of this character.

I would not have it interfere in the least with the local self-government of each of the several communities of which it is composed, but I would most assuredly give it power to control the purity of the water supplies, and to direct such communities to take proper steps for the general acquisition of pure supplies, adequate drainage, and proper disposal of wastes.

Such a district and such a commission will have to be created by the state, necessarily, and by means of a law, carefully prepared, something after the type of the Metropolitan Sewerage District of Boston or London, but, I hope, avoiding some of the evils of the Sanitary District Law of Chicago. In my opinion, the Sanitary District Law of Chicago, limiting the district, as it did, to the construction of a certain kind of channel or channels, without the authority to build intercepting sewers, sewage disposal plants, water filtration plants, or to properly protect the water supply, was a misdirected law, which has only in part accomplished its purpose, and which must inevitably be in the near future entirely revised to meet the new situation of sanitary danger which is now impending over Chicago.

The Sanitary District Law of Chicago was originated by those who were desirous of seeing a commerce channel created, making this the primary purpose rather than sanitation. The result has been that neither have we a channel for commerce which can be utilized for many years to come, nor have we the best methods of sewage purification or sewage disposal. If there shall be channels incidentally and necessarily connected with adequate drainage, let them come. But do not let us prostitute our sanitary requirements in any way to the visions of a commerce which has not yet arrived. I believe in commerce channels. I am certain that we will one day have a great waterway from the lakes to the Gulf, but I cannot, with equanimity, view the possibility of neglecting our sanitary requirements in an ill-advised attempt to promote commercial channels, the demand for which is not yet apparent. The topography of this district is such that they can be easily constructed when required, and I fully expect to see a channel of the Sanitary District of Chicago connected with the whole south shore of Lake Michigan, and having upon it the commerce which is an ample justification for its construction.

But our first and greatest duty to the generations which must follow us here is to provide them with a pure water supply, adequate drainage and sewerage.



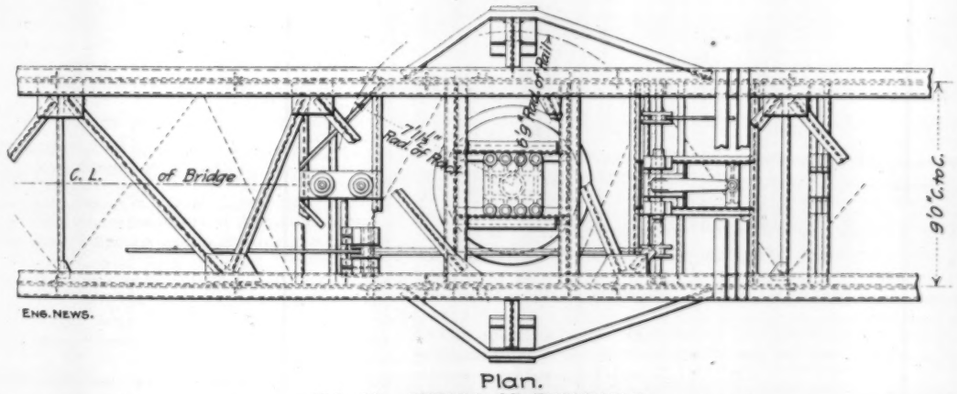


FIG. 3A. DETAILS OF TURNTABLE.
(Railway Datum.)

THE HYDRAULIC METHOD OF HANDLING EARTH.

There are very great opportunities for the hydraulic method in the construction of earth dams and levees, in making the cuts and fills for railway embankments and in filling depressions by removing material from one locality and transporting it to another.

Where the conditions are favorable, an earth dam can be built more substantially and more economically by this method than by any other.

Millions of cubic yards of gravel have been displaced in California by hydraulic process, and the gold extracted therefrom, at a cost of less than 1 ct. per cu. yd. aside from the expense of furnishing the water.

In the building of dams it is an open question whether a greater expense incurred by this method of depositing the material may not be justified, by reason of the greater security of a structure built up in this way. Its solid compactness and greater stability hold out every inducement to make use of hydraulic processes. This may be said with equal assurance of other embankments, because the settlement of such structures after completion by this method is practically *nil*.

Most localities where dams are contemplated will have a sufficient available supply of water for such purpose if it is pumped and the same water used continuously.

Where a sufficient pressure is obtainable, a hydraulic elevator may be installed to lift the earth from the reservoir bottom to the height of the lower portions of the embankment, leaving but a comparatively small part of the upper work to be completed by another process.

In the building of levees the hydraulic method is particularly well adapted, because it is not only economical to use it, but it will also make an extremely stable and solid embankment, one that cannot be made equally stout and firm by any other process. The conditions are generally favorable to utilize it, too.

It requires some skill and experience to obtain the best there is in hydraulic work to build dikes and levees, but in the consideration of the great amount of such work to be done, there is every reason why the civil engineer should acquire a practical knowledge of this useful method.—From a paper by H. A. Brigham, "Practical Methods of Examining and Fitting Up a Hydraulic Mine," read before the Technical Society of the Pacific Coast, Aug. 28, 1908, and published in the "Journal of the Association of Engineering Societies" Oct., 1908.

PROPOSED STRUCTURAL IMPROVEMENTS FOR THE ELEVATED TERMINAL LOOP AT CHICAGO.

The elevated loop which forms the downtown terminal of all the elevated railways in Chicago has for some years been subject to continual criticism. This is aimed mainly at two different features: (1) the defective train service due to the inadequate traffic capacity; (2) the noise, and the obstruction to light.

The question of the traffic capacity was discussed in our issue of Sept 24.

It has been suggested that when the proposed subway system is built the loop structure should be removed and the trains of the elevated railways operated underground. Careful investigation will be necessary to determine whether this is practicable. The subway system is designed primarily for the street railway service (in order to relieve the streets from this large element in traffic congestion), and it is a question whether it can be given sufficient capacity to handle efficiently the enormous concentrated traffic of elevated railway trains and surface street cars. The subway system, however, is a thing of an indefinite future period.

Some improvements in present conditions on the loop are needed urgently, without waiting for the possible future removal of the structure Numerous suggestions for and reports upon such improvements have been made by different engineers and others. One of the organizations which has taken up the question is the Loop Protective Association, representing property owners along the line. It engaged Mr. Charles K. Mohler* as its engineer, to investigate the conditions and report as to improvements that may be effected. His report, which has been issued recently, suggests improvements both in methods of operation and in some details of the construction and equipment. It will be of interest to consider some features of these latter, omitting (for the present) all consideration of the proposed changes in methods of handling the trains.

STATIONS.—The station buildings (containing the ticket offices and waiting rooms) are on a level with the platforms, and extend over the sidewalks. The total width of the railway structure is about 20 ft., and the width over the platforms at stations is from 34 ft. to 49 ft. The maximum width at the station buildings is about 100 ft., the buildings extending back into the cross streets. On Lake St., however, the stations are narrow and have no waiting rooms. The widths of the streets and structure as given in the report are shown in the accompanying table:

Streets.	Width of structure over platforms, ft.	Width of street, ft.	Width of street covered by structure, per ct.
Van Buren St.....	42	66	63.6
Wabash Ave	49	100	49.0
Lake St.	34	80	42.5
Fifth Ave	49	80	61.2

The tracks are at a sufficient height to permit of footbridges beneath them at the stations, so that passengers can ascend stairways on either side of the street to reach either side of the station. The report suggests that the ticket offices and waiting rooms should be removed from the platform level, and established at the level of the footbridge beneath the tracks. This would reduce the obstruction to light caused both by the area and height of the present buildings, and the width and height of the altered station would be within the limits of the station platforms. This plan has been adopted for stations on the South Side Elevated Ry. (Chicago), and was described in our issue of June 4, 1908. This arrangement would also permit of convenient passage from one platform to another in the event of the different railways adopting eventually a mutual transfer system.

It is suggested by the report that the obstruction to light might be reduced still further by replacing the present "umbrella" shelter roofs over the platforms with roofs of the "butterfly" type, sloping downward from each edge to a center line of posts. Thus the highest point of the new roof (just clearing the roofs of the cars) would be at the level of the lowest part of the present roof. The roof covering might be of wire-glass instead of opaque material. Prism glass, as used for sidewalks and vault lights, might be used for flooring that part of the platform which covers the waiting rooms (supposing the latter to be put below the tracks, as noted already).

The width and arrangement of the stairways at some of the stations are unsatisfactory for handling crowds. The report suggests that the stairway accommodation may be increased in three ways: (1) providing stairways 5½ ft. or 6 ft. wide, instead of 4 ft. as at present; (2) providing connections with stairways in business and office buildings; (3) providing separate stairways for incoming and outgoing passengers at points of extreme congestion. We may note that there are already connections with a few large dry-goods establishments, to accommodate the shopping traffic. Other connections were proposed at one time, but the necessary bridges over the sidewalks were objected to, and permission for their construction was withheld.

The report suggests also that the stairways may be of light truss construction, that the risers might be omitted, and that the space under the bottom of the stairway should be filled to a height of about 3 ft., as this space serves only for the collection of dirt and rubbish. The second suggestion (intended to reduce the obstruction to light) may be questioned, as the open steps would be liable to cause confusion and stumbling on the part of elderly or nervous persons ascending such a stairway. It might be practicable for stairways used exclusively for exit purposes.

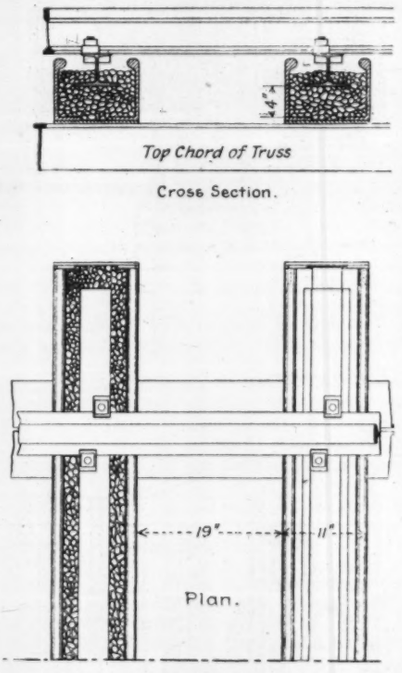


Fig 1. Track Construction with Steel Troughs for the Ties.
(Suggested by Mr. C. K. Mohler for the elevated loop railway in Chicago.)

Some of the stations have special exit stairways at the ends of the platforms. These are convenient only for a small proportion of the passengers, and they are very little used. In some cases the platform gates of these stairways are not opened. As the stairways are obstructions to light and to street traffic, and as they are of little use, their removal is recommended by the report.

Each of the two tracks of the loop carries the trains of two railways. Under the present method of operation, each platform must be long enough to accommodate ten cars, as each half of the length is reserved for the special use of one of the railways. The present platforms limit the trains to five cars, and extensions of the platforms have been suggested many times. In fact, the stru[illegible] work for the extensions was built several [illegible]ths ago at some stations, but the completi[illegible] the platforms was stopped by the courts. [illegible]s was due largely to the objections of prop[illegible]owners on the ground of damage to property additional obstruction to light.

The present reports of the Loop [illegible]ctive Association's engineer is opposed t[illegible]se extensions, and it is stated that the a[illegible]tages are so limited as not to justify the [illegible]ctionable features. The advantages would [illegible] realized fully unless trains of the two [illegible]ays ran alternately, whereas the number of [illegible]ns varies on the different lines. Where the [illegible] of two trains belongs to the same road as t[illegible]rain preceding, it must wait for the first to [illegible]e its station stop at the proper platform [illegible] get out of the way. It may, however, fol[illegible] the first slowly into the station. If the first [illegible] is that of the railway using the rear portion [illegible]he platform, and the second train is that [illegible] the railway using the forward portion, the [illegible]ter train must wait outside the station and t[illegible] pull up to its proper platform.

During the busy hours of the mor[illegible]ng, however, trains are allowed to stop to [illegible]nload at either end of the platform. This cann[illegible]t be done in the evening, when the rush is to [illegible]e trains of two different railways. The report recommends that each platform be made [illegible]ne unit, used jointly by the two railways. This would permit the use of trains of seven cars. It is also suggested that alternate stations might be used by the two railways, instead of having every train stop at every station. This, however, would be liable to cause considerable confusion for persons going to the trains.

FLOOR AND TRACK CONSTRUCTION.—The structure has an open floor consisting of wooden ties laid upon the top chords of the four lines of longitudinal trusses. These ties carry the rails and guard timbers. An experiment has been made with a ballasted floor in order to reduce the noise. It consisted in closing the spaces between the ties by bottom planks, and filling gravel between the ties and over the base of the rails. On one part, the gravel was filled only under each rail, the middle part of the track being left open (Engineering News, Feb. 21, 1907). On another part, the filling extended the whole width of the track. The results were unsatisfactory, largely for the reason that the direct contact between rails, ties and structure was left unbroken.

The report suggests three systems of floor construction: (1) a solid steel floor with concrete and ballast covering; (2) a ballast-filled trough for each tie; (3) a longitudinal trough (with ballast) for each rail. Whether the small amount of ballast in the two last methods would provide against noise and vibration, and would maintain the track in good surface is open to question. The solid floor system proposed is that of the Philadelphia elevated railway, in which longitudinal steel troughs rest on cross girders 10 ft. apart. A simpler arrangement for the Chicago structure would be a floor of transverse troughs resting on the present trusses. This is, of course, assuming that the structure is strong enough to carry such an increased dead load (for which it was not designed), or could at least be made sufficiently strong at reasonable expense. The report is silent on this point, however, and it may be found on investigation that an improvement of this kind would be impracticable.

The following is an extract from that part of the report which deals with the floor and track construction:

> There are a number of constructions which can be employed for the roadbed carrying the rails and ties, so as to dissipate and absorb most of the noise-producing vibration originating from the rolling of wheels on the rails and over rail joints, etc.
>
> The main factors instrumental in attaining this end are: (A) Some inelastic medium, such as broken stone, placed under the ties and rail supports to break up the rigid continuity. (B) Increased mass of the supporting medium below and in addition to the ballast, to absorb, in part at least, the vibration before it is carried into and set up in the broad thin plates of the girders and parts of the structure under tension.

*Consulting Engineer, 401 Heyworth Building, Chicago.

The most successful construction in this connection, to the knowledge of the writer, is that employed by the Philadelphia Rapid Transit Co. for its elevated line. Cross girders are placed at intervals of about 10 ft., and on top of these are carried shallow steel troughs, in and over which is placed a solid bed of concrete about 4 ins. deep over the lowest portion of the inverted trough. On this is a bed of stone ballast, 6 ins. deep under the ties and filled in even with their top surfaces. This, while rather an expensive construction, and forming a solid covering over the railway, is very effective in the elimination of the noise which would otherwise result from the operation of trains. The roadbed is practically watertight.

The noise from the operation over this structure seems to be as nearly eliminated as is possible on elevated construction. When standing on the street a short distance away the noise made by the passage of a train over the structure is not as noticeable as that from a car, moving over the surface track beneath. As a matter of fact, only two damage suits have been started against the company on account of noise. One of these was discontinued for lack of evidence.

In Fig. 1 is shown a design for roadbed consisting of steel troughs built up of plates and bulb angles, and filled with stone ballast. Steel ties are embedded in the ballast for carrying the rails. The spacing is such as to leave 19 ins. clear space between troughs.

In Fig. 2, the rails are bolted to steel plates. The rail and plate are carried on stone ballast filling placed in the built-up steel trough running parallel to and carried on top of the longitudinal girders. It would not be open to the objection of cutting off all the light, as would be the case with solid floor construction, and would probably add the least weight and cost the least of any sound-deadening device that could be employed on the old structure. If the trough were filled with broken stone, over the base of the rails, it would act as an absorbent of the vibration set up in the rail itself. No construction of this character has ever been employed, to my knowledge, but I know of no reason why it could not be used to advantage.

In some cases a combination of the Philadelphia type of construction with either of the trough designs shown in Figs. 1 or 2 might be made. For instance, where it is undesirable to have all the vertical light cut off from the street below. By using 60-ft. rails with the Philadelphia type of construction for a length of 6 ft. or 8 ft. at the joints, and the open steel trough construction for the balance, very satisfactory results probably could be obtained.

While the use of guard rails is an essential for safety, none are shown on the drawings for the reason that they form a detail apart from sound deadening. It is believed that in some cases an inside guard projecting well above and bolted to the running rail could be employed to advantage. This would cut off much less light than the wooden inside guard now used, and should be quite as effective.

Most of the noise vibration originates at the rail joints from the pounding by the wheels. Half of this could be eliminated at once by the adoption of 60-ft. rails instead of 30-ft. rails now used. The pounding and resulting noise at the joints could probably be very materially reduced by the adoption of an outside splice bar which comes up with a gradual slope to a height a fraction of an inch above the head of the rail. By that arrangement, the splice bar will receive the wheel tread and carry the wheel and load over the gap between the rail ends at the joint, without allowing the consequent pounding on the rail joints and almost instant reversal of the shear, as is the case with the ordinary splice bar. The outside splice bar would serve the function of a girder in carrying the wheel over the weak spot in the joint. As designed, the splice bars are 4½ ft. long and have eight bolts. There would be no bearing between the splice and the rail for part of the distance between the widely spaced bolts or at the quarters. That, with the extra length will prevent very largely the hinge motion which takes place with the short splice bar. The bar made in this way should be of extra quality steel to resist the unusual wear that would be brought upon it.

Splice bars similar to those above described have been tried at different times on steam railway track. On account of the great variation of rolling stock, badly worn wheel treads, heavy loads and high speeds, they have not proved very successful. For the elevated railways, however, where the wheels can be well maintained and the loads are not excessively heavy, very good results should be expected.

A splice bar of this type has been employed on the Chicago & Oak Park elevated line. This, while quite an improvement over the old joint, is apparently not giving as satisfactory results as might be hoped for. It is not employed under favorable conditions, neither do the details of the design appear to be the best that could be used. The splice bars (as applied to the old worn rails) are too short, of insufficient depth, and too thin to give the necessary stiffness and resistance to wear and crushing.

REDUCTION IN NOISE.—The report states that most of the noise due to the movement of trains is caused by the passage of the wheels over the rail joints. Means for reducing this have been mentioned above. The problem of noise reduction and the suggested encasing of the steel structure with concrete were discussed in our issues of Nov. 17 and Dec. 15, 1904, and March 23, 1905. This latter was in regard to the report by Mr. B. J. Arnold. Other causes of noise, with remedial measures, are mentioned by Mr. Mohler in his report as follows:

1. Structure.—Even with the changes in roadbed and track above suggested, it may be necessary to employ still other expedients to prevent vibration (which may be carried into the structure) from producing noise by its action on the broad thin plates and members under tension. It is believed that in many cases creosoted planks could be bolted to the vibrating and noise-producing parts of the structure in such a way as to very materially reduce, if not prevent, the noise. In some cases felt placed between the planks and the members to which they were applied might prove more effective. In still other cases, casing with concrete may be the better expedient.

2. Motor Gears.—There does not seem to be much promise for noiseless motor gears. About the most that can be hoped for is to have them reasonably well maintained, and have the vibration absorbed in the roadbed construction before it is carried into the structure. The noise is made worse on account of the vibration being carried into the car body and there acting on the resonant and loose parts of the car, as well as being carried into the structure with the present roadbed used. Some of the noise might be eliminated by housing or casing the motor and gears so as to confine the vibration as much as possible. This should at least be given a trial.

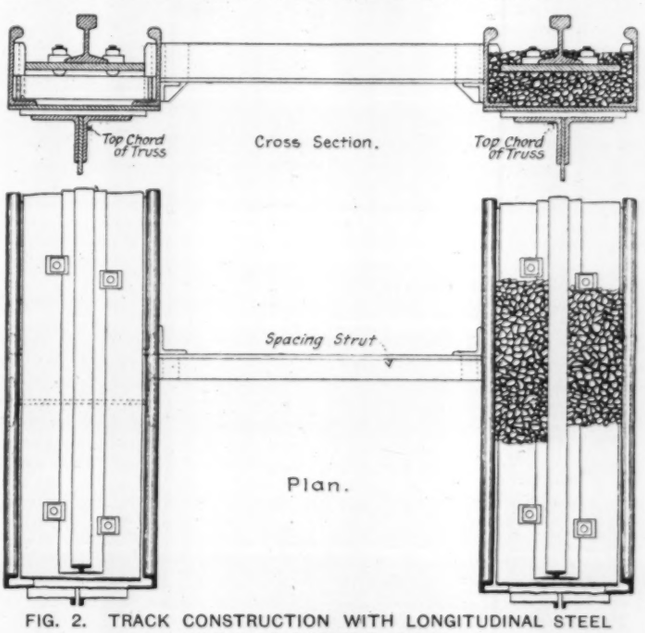


FIG. 2. TRACK CONSTRUCTION WITH LONGITUDINAL STEEL TROUGHS FOR THE RAILS.

(Suggested by Mr. C. K. Mohler for the elevated loop railway in Chicago.)

3. Air Brake Exhausts.—The orifice of the air brake exhausts should be changed and mufflers employed, dispensing with that noise feature entirely at a trifling cost. It has already been largely taken care of by some of the roads.

4. Rattling of Loose Parts.—This noise can be almost, if not wholly, remedied by proper construction and maintenance.

5. Curves.—On account of the short radius of the curves, and both wheels being rigidly fastened to the axle, the slipping of one of the wheels on the rail is inevitable. This results in grinding and screeching noise. I know of no way to prevent this, aside from the employment of some lubricant on at least one of the rails.

6. Pneumatic Interlocking.—The noise from the exhaust can be entirely prevented by changing the exhause port and putting on exhaust mufflers. As the movement of the interlocking must be quick and positive, it will be attended with more or less noise. It is believed the noise could be prevented in part.

7. Crossing Frogs.—The noise from this cause is almost deafening. It is the worst and most unbearable noise resulting from the operation of the road. At some junction points the wheels pass over eight crossing frogs in addition to the switch or turnout frog. The excessive noise can be reduced in part by the use of a solid floor and stone ballast to carry the track at these points.

8. Brakeshoes.—The screeching and chattering produced by the rubbing of the brakeshoes on the wheels can be reduced largely (if not prevented entirely) by the use of proper metal and properly hung. The hangers should be attached in some way to the equalizing bars of the trucks, instead of to the truck frames.

MISCELLANEOUS IMPROVEMENTS.—The protection of the third-rail conductor is suggested in the report, in order to insure more reliable service during winter sleet and rain storms. This protection would also reduce the danger to employees working on the track, and to passengers who might be compelled to leave the trains and walk upon the structure in case of traffic being blocked.

Other matters include the following: (1) a better system of signs on the trains and on the station platforms, the trains having signs at the entrance to each car; (2) the use of wider sliding end doors and center side doors, with electric door signals to automatically signal the motorman when the last door is closed; (3) improved brake hangers. As to the last, we give the following quotation from the report:

> By the adoption of positive or fixed brake hangers, attached in some way to the equalizing bars of the trucks, a quicker stop could be made. With the present hangers attached to the truck frames, when the brakes are applied and grip the wheels, one of the truck springs is compressed and the other is released a corresponding amount. The springs are held in this position until the instant at which the forward movement of the car ceases; then the reaction of the springs rotate the wheels backward, giving a disagreeable, and at times even dangerous, backward lurch to the train.
>
> In addition, when the train is coming to a stop, on account of the "balance" between the compression of the springs and the grip of the brakes on the wheels, any increase or decrease of the grip on the wheels, has a tendency to produce a jerky motion to the car as soon as the brakes are applied. In order to prevent in a measure the disagreeable backward lurch at the instant after the forward motion stops, it is ordinarily the practice to begin releasing the brakes before the train has come to a stop, thus consuming more time in bringing it to rest.
>
> Another feature of the jerky motion and severe backward lurch of the train, as affecting operation and causing delay, is that passengers in many cases cannot with comfort or safety leave their seats to be at the door ready to alight at the instant the train stops, and as a result remain seated until it is actually at rest. If a positive hanger were employed it would be possible to keep the brakes applied to their maximum efficiency until the full stop could be made and not produce the disagreeable backward lurch at the instant of stopping or surging before the stop is reached.

APPEARANCE OF THE STRUCTURE.—The report deals briefly with the general appearance of the structure. It recommends (among other matters) that it should be painted a light color. This has been tried already, with unsatisfactory results (Engineering News, Oct. 2 and Nov. 20, 1902). The effect was pleasing for a short time, but very soon the effect of dirt, dust, rain and atmospheric influences was to give a dirty and streaky appearance. This was more unsightly than a darker color which would not show these surface markings.

In some cases the structure has been used for purposes other than handling traffic. Electric lights and the wires for distributing the current attached to it. The lamps are suspended from very light inartistic brackets attached to the posts. The wires are strung promiscuously.

The unsightly appearance of the structure could be modified and relieved to a certain extent. For the purpose of illumination, brackets of somewhat massive appearance to harmonize with the structure, and of curved outlines, could be attached to the outside of the posts. From these electric lamps a suitable design could

be suspended. The feed wires should be as large as can be consistently allowed. They should be suspended from the ends of the curved brackets, over the lamps, and left loose enough for considerable sagging to produce curves of pleasing outline.

By painting the structure some light sightly color it could be made much less objectionable in appearance than it is at present, or has been for some time. The prevention of deterioration by rust and corrosion by frequent painting would perhaps more than justify the expense, even if the appearance of the structure were not a consideration.

The whole question of improving the appearance of the elevated structure and securing effects which would in any way add to civic beauty, is of such a public nature and importance as to deserve attention and study by artists and architects best qualified to judge and work out details relating to that feature. It is to a certain extent outside the province of engineering, but could very properly be made a subject of competition for suggestions and design.

THE DE MURALT SYSTEM OF REINFORCED-CONCRETE SHORE PROTECTION.

By RUDOLPH WELCKER.*

Considerable interest has been recently shown on the continent of Europe in a new application of reinforced concrete for the protection of seashores. The invention referred to, which has already been patented in America, is due to a Dutch engineer, Mr. Robert L. de Muralt. Remarkably favorable results have been attained through the application of the system, particularly throughout the terrific storms of March, 1906, which damaged the shores and dikes of Zealand, and caused widespread distress and devastation throughout the province.

There is no doubt that the country of Holland is more unfortunately situated in regard to its susceptibility to sea erosion than any other country, since a large part of it is actually under sea-level. This necessitates a perennial effort on the part of its government engineers to defend its coast line. These efforts are concentrated upon devising more adequate and more economical means of protection. The de Muralt system is the latest result, and though of simple construction, the application is manifold.

Hitherto, reinforced concrete has been employed in shore protection, either in monolithic form, or in the form of large slabs simply joined together, and separated by artificial joints of different kinds. This mode of construction presents the disadvantage that flections due to the thrust of the earth, to frost, to the action of the waves, etc., give rise, at the principal surface of the concrete, to fissures, through which the water finds its way, is enabled to attack the reinforcing of the concrete and to disintegrate the facing, so that the constituent portions thereof are speedily detached. Moreover, the water which penetrates through these fissures tends to undermine the slopes of the embankment, causing eventually far greater injury than is actually apparent.

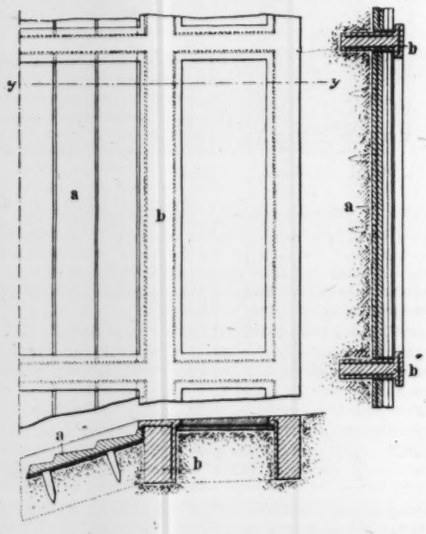


Fig. 1. Plan and Sections of the De Muralt Reinforced-Concrete Foreshore Protection.

The improved system of applying reinforced concrete may be followed by examining the accompanying figures. The fundamental principle, as applied to facing and groins, is based upon the use of slabs of comparatively small area, independent of one another, and held in place by a frame, also of reinforced concrete, which is anchored to the ground, and covers the margins of the slabs so as to form lap-joints.

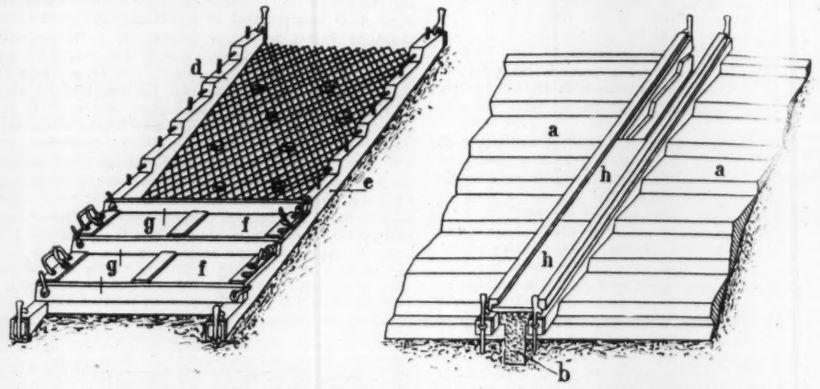


FIG. 2. PERSPECTIVE OF THE FORESHORE PROTECTION IN COURSE OF CONSTRUCTION.

The external surface of the slab is by preference of stepped form, with the view of diminishing, in case of marine embankments, the upward wash of the water, to break the waves as they strike, and to reduce their destructive scouring influence when returning. Moreover, this form of slab possesses the advantage of enabling the embankment to be walked on, whatever its inclination may be.

The reinforcement, consisting of expanded metal, is laid on the carefully leveled slope on a thin layer of concrete (Figs. 2-3), and fastened down by short stakes. Notched wooden frames are subsequently laid transversely upon the prepared surface, and the process of filling the molds corresponding to each step is commenced from the bottom. Cast-iron hammers of the size of the meshes of the metal are used for ramming. Wooden shutters secured to the side-beams by iron bolts are placed on top after completion of each slab. The construction of the reinforced-concrete frame is begun after the completion of two panels of the slabs. Ditches 1½ ft. deep are dug between the slabs, the transverse notched wooden beams turned upside down, and the mold is ready, after inserting the reinforcing.

The concrete utilized for the section washed by flood-tide is composed of a mixture of 3 parts Portland cement, 5 parts sand, 8 parts gravel and ½ part trass cement. The sections above mean high level are made of a mixture of 1:3:4 cement, sand and gravel. These are the fundamental ideas in short, and for every condition special changes can be made in accordance with the circumstances.

The efficiency of the de Muralt system has been already amply demonstrated under the severest conditions, and has been successfully introduced into France and Germany. The United States, with its extended shore-line, the great lakes, and the future improvement of the navigable rivers, offer a tremendous field for future work, especially when it is possible to apply a cheap and adequate system of defence, instead of the customary expensive monolithic sea-walls.

*Engineering Dept., Public Service Commission of the First District of the State of New York, New York City.

THE UNITED STATES DREDGE "CLATSOP" has just started from Philadelphia under its own steam for a 17,000-mile journey around Cape Horn to Portland, Ore., where it is to be used in government work. The dredge, which is 185 ft. long, is expected to make about 8 miles an hour, so that, allowing for delays, it should reach its destination about the first of March. In our issue of Dec. 3 we noted the recent departure of a Fruhling dredge from Germany on a similar voyage to the Fraser River in British Columbia.

HOW A PRIVATE GAS COMPANY AT IN[DIANA]NAPOLIS IS CONTROLLED IN THE PUBLIC IN[TER]EST.*

By CHARLES CARROLL BR[ADLEY]†

Whatever may be the success of efforts [to con]trol public service corporations through state [legis]lation or otherwise, the fact remains that the best result is obtained when it is made definitely to the interest of the company to give good service. Whatever [method] of producing this result will benefit the community, whether in actual cash received by the city treasury or in reduced rates to consumers, or in satisfactory service.

The franchise granted to three personal commercial organizations in the city of [Indianapolis in] 1905, which has since been transferred to the Citizens' Gas Co., is such a franchise and its terms are worthy of study by companies proposing to start public service industries as well as by cities and companies proposing to make new contracts for service.

The origin of the franchise was in one for a company formed to supply Indianapolis with natural gas late in the '80's, in which Alfred F. Potts was one of the prime movers. Mr. Potts described the company and gave the principal provisions of the franchise in "Municipal Engineering," Vol. xiv., p. 182. The controlling feature in this company was the transfer by the stockholder in his subscription for stock of the entire control over his stock, except the receipt of dividends and the right to transfer the ownership, to a named board of trustees, who elected directors, thus precluding the possibility of any competing company or hostile element securing control of the company. There were many other good features in the organization, most of which were transferred, together with the one described, to the franchise of the Citizens' Gas Co.

The natural gas company was obliged to go out of business when the supply of natural gas was exhausted, the courts deciding that it had no power under its charter to enter other business, such as the manufacture of gas. After long continued litigation the natural gas company's mains within the city were sold to the new Citizens' Gas Co., organized to manufacture and sell artificial gas at a low price. Some of the provisions in English gas franchises were added to those carried over from the old company, and the result is described here as an indication of what can be done in making a public service corporation really a public servant at the same time that it gives adequate returns to its stockholders.

The company is now constructing a gas plant and is repairing the old mains, and at some time early in 1909 will be ready to furnish gas to its customers, many of whom are already on its lists for connection as soon as the gas is ready to deliver. The company points to the eminent success of the old natural gas company as evidence that its plan is good, and that success is accepted as evidence that the plan described is no experiment, but will demonstrate its satisfaction of all expectations.

The ordinance, approved Aug. 30, 1905, approves a contract made by the Board of Public Works with Alfred F. Potts, Frank D. Stalnaker and Lorenz Schmidt, and certain fundamental terms of this contract, according to one of its provisions, are included in the state charter of the Citizens' Gas Co., to which the contract with the city was transferred by the three gentlemen named.

The charter broadly gives the company the power to supply Indianapolis and its inhabitants with light, heat and power.

The capital stock of $1,000,000 can be increased at any time by submitting the additional shares to sale at public auction on 30 days' published notice, any premium to go into surplus, and not to bear dividends. It

*A paper read before the American Society of Municipal Improvements, at Atlantic City, N. J., October, 1908.
†Consulting Engineer, Indianapolis, Ind.

is provided that if extensions of mains are desired, and they cannot be obtained under other paragraphs in the contract, the petitioners for extensions may subscribe for stock sufficient to lay the mains and sign contracts for gas sufficient to pay the interest on the cost, but even then the stock must be put up at auction and must be purchased at par by the petitioners in case it is not sold at a premium at the auction.

These provisions insure that the stock shall always bring its par value into the treasury, and that the dividends paid shall be on this par value, no more and no less. The necessary extensions are also provided for

FIG. 3. VIEW OF PROTECTION DURING CONSTRUCTION.

without overburdening the company, while at the same time giving the property owners large interest on the money invested in the extensions and ultimate return of the principal as well.

The capital stock, by the terms of the subscriptions, therefore, under one section of the contract, is placed in the control of a board of five trustees, stockholders, and must be voted as a whole. This Board of Trustees was named in the articles of incorporation, and the Board fills all vacancies, except that one member was nominated by the Mayor of the city, and a vacancy in this particular office is filled by another nomination by the Mayor. Failure of the Board of Trustees to fill a vacancy gives any stockholder the right to petition the Circuit Court to make the appointment, which it must do if the Board fails to act during ten days.

This provision keeps the company in the control of the Trustees, even if the stock is all bought up by a competing company. The original Board is one in which the people have the fullest confidence. The old gas company stock was largely bought by a hostile interest, but the Board of Trustees retained the control and operated the company for the public's benefit until it was wound up by the courts, although the hostile interest did everything possible to secure the property of the company, and prevent its devotion to the best interests of the public, which was the real owner of the company, all the original investments in stock having been repaid with 8% interest. The Board of Trustees of the new company is expected to be equally steadfast in carrying out the original purposes of the founders of the company and the investors in its stock.

Any member of the Board of Trustees can be removed by the Circuit Court on showing that he is an employee or a holder of stock or other securities of any company delivering or purposing to deliver gas in the city, or for corrupt practice or misconduct detrimental to the company's interest.

The board of nine directors is elected each year by the Board of Trustees, to manage the business and prudential concerns of the company. This relieves the Board of Trustees of all duties, except that of securing competent directors independent of any influence detrimental to the company, and makes it possible to enlist as trustees men of the highest class and possessing the fullest confidence of the citizens and stockholders, without the opportunity to refuse on account of pressure of business or temporary condition of health.

Stockholders are entitled to cumulative annual dividends of 10%, payable semi-annually. The earnings of the company are devoted first to the payment of matured debts and operating expenses; second, to the payment of the dividends semi-annually and unpaid accrued dividends; third, to the extensions and betterments ordered by the Board of Public Works; and fourth, to repayments of stock subscriptions, thus reducing the capital upon which 10% dividends must be paid. When the stockholders have been repaid their entire subscriptions with 10% interest the stock is cancelled and ownership by the company ceases, and it is wound up.

The old company had the same provisions in its franchise, except that the dividends paid were 8% and the ownership on repayment of stock subscriptions did not pass to the city. The old company paid back all its stockholders and had property valued at a half million or more when it was wound up. Its franchise provided that in this event gas would be furnished at cost, but almost simultaneously with the complete repayment natural gas gave out, and the company was deemed by the courts unable to manufacture gas. An attempt was made to declare the property of the company, particularly a good system of mains in first-class condition, public property, to be transferred to the new company to be formed with power to manufacture as well as distribute gas. The courts decided, however, that the property belonged to the stockholders, notwithstanding their stock had been fully repaid, so the property was sold to the new company at an appraised valuation under the city's option to purchase, and the stockholders received a large additional dividend after dividends equal to the original investment, plus 8% interest, at the same time that the new company obtained a distribution system at a fraction of the cost of a new system. The ultimate ownership question is settled in the new company's franchise by transferring the property to the city when the stockholders are fully paid.

The state charter fixes the life of the company at 50 years, and the contract with the city is for 25 years. If the stockholders are not all repaid in 25 years the Board of Public Works may require the company to bond itself at 6% for the amounts due the stockholders, pay them off, and then transfer the property to the city, subject to all indebtedness, including these bonds, or may pay the amount due the stockholders itself and thus secure the property. In case the company becomes insolvent the city can acquire the property by paying or assuming the company's debts, including that due to stockholders for still unpaid subscriptions.

The company is required to make semi-annual detailed statements of its affairs, including assets and liabilities, disbursements and receipts, and publish them in two newspapers. The city controller can investigate the books, to check the reports or otherwise, and the city engineer can examine the plant at any time.

The gas furnished must have at least 600 B. T. U. per cu. ft., and the price must not exceed 60 cts. per 1,000 cu. ft.

There are the usual provisions protecting the city and citizens during construction, giving rights of way, insuring compliance with the terms of the franchise, etc.

There was some discussion of the propriety of inserting one common English provision, whereby an increase in allowable dividend rate would accompany a reduction in price, but this was finally dropped; the English companies continuing in business, while this company may be wound up in 25 years.

The principle behind the organization of these companies was the same as that behind many similar organizations; the joining together of public-spirited citizens to supply a needed public service at reasonable cost. The results differ, because in these cases private interest was not permitted to secure control, and the public nature of the service is retained, and the public receives the benefit after the capital invested has received its predetermined just reward. The old company would have continued in business, furnishing natural gas at cost, if the supply had not given out. This plan was, perhaps, better than the new one, of transferring the plant to municipal ownership when the capital invested has been paid off, but the public nature of the business is fully recognized in any event.

The vigorous public campaigns for the sale of stock at $25 a share on monthly payments resulted in many small stockholders, who become consumers and workers for the company, thus making easier the securing of business by the company.

The certainty of no water in the stock, and the publicity of accounts, as well as the supervisory power of the city officers, insure reasonable fixed charges and minimize the dangers of political manipulation, useless employes, misapplication of funds, so that the low price fixed for gas may be predicted in advance with reasonable certainty, and protected from unfair attack. The public interest in the company makes friends for it. The high character of trustees and directors promises the best of management, based on the highest principles and for the public benefit. The permanence of these boards and the continuance of their high character, as demonstrated by experience, gives this plan a great advantage over municipal ownership.

The original company was formed to enter into business in competition with companies seeking the same opportunity at much higher rates, and was the result of public enthusiasm over a new fuel and the determination to secure it at reasonable rates, so that the consumers, rather than the promoters of the companies, would reap the benefit from the unexpected bounty of nature. The new company was formed to secure the existing mains of the old company and to continue this benefit in the more common field of gas manufacture. But the success of the first company and the successful fight of the new company against all sorts of opposition to its establishment demonstrate the soundness of the principle, and, while some other similar company in the gas field, not being able to secure a distribution system at a low price, may need to start with a higher price for gas at the beginning than the Indianapolis company has established, it can secure the other benefits, and the adoption of the graded scale of increase of dividend rate with decrease in price will give an impetus toward saving in cost, which, judging from English results, will produce even better results than those assumed in Indianapolis. There is no apparent reason why the method should not be applied to other public service industries, and be equally successful.

FIG. 4. FINISHED REVETMENT.

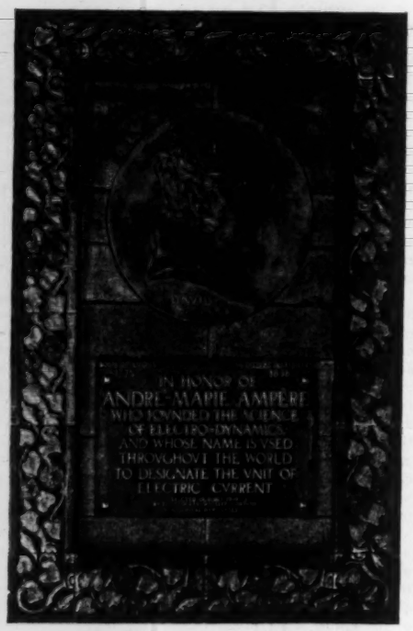
NEW RECORD FOR LADDER DREDGES.—A new dredging record was established for ladder dredges (at Panama) in October, when the ladder dredge "No. 1" of the Atlantic dredging fleet excavated 168,796 cu. yds. of material. The best previous record for ladder dredges was made in March by the "Gopher" of the Pacific dredging fleet, which took out 168,375 cu. yds. "No. 1," the dredge that now holds the record, was working during October in the channel in Limon Bay and the material handled was a mixture of mud and rock.—"Canal Record," Nov. 11.

A TABLET TO THE MEMORY OF ANDRE-MARIE AMPERE.

A tablet to the memory of Andre-Marie Ampère, the famous French scientist, was presented to the Lackawanna R. R. by the Crocker-Wheeler Co., and unveiled in place at the Ampere Station (East Orange, N. J.) of that road on Dec. 3, by the French Ambassador to the United States, Jules Jusserand.

Parts of the speech of Mr. Jusserand are appended, as they reflect a Frenchman's view of the famous electrician's personality.

I have been asked to be present at this beautiful ceremony for several reasons, one of them being that I come not only from the same country, but from the same town as Ampère—that great manufacturing town of Lyons. Lyons is one of the oldest cities in France and one of the most peculiar. It is a Roman town. For a long



A Tablet to the Memory of Ampere.
Erected in the Ampere Station (East Orange, N. J.) of the Lackawanna R. R.

time it was the foremost in France. It was among the first to receive Christianity and during the Renaissance it was at the head of the towns that received the new learning and that spread the art of printing. The town is cut by two rivers. Owing to that its atmosphere is of a gloomy and austere sort, which makes it very different from other towns in the same latitude. The temper of the inhabitants is also somewhat peculiar. They are much less southern than you would think when you look on the map. They are more thoughtful—more involved in their thought. They are much more meditative. The town produced large numbers of artists and thinkers.

In that town was born Ampère. He belonged to one of those austere French families of which you never hear—which are very rarely selected as a subject for novels and which are the average French family. Of that type was the family of Ampère. His father was justice of the peace. He followed during the revolution the dictates of his conscience and suffered for it. He was beheaded and a few hours before his death he wrote in a firm, steady hand, his farewell to his wife who had been the faithful companion of his life.

I have in my heart as a consolation the knowledge that I did my duty without fail. I leave you poor, but you will remember that it was through no squandering of mine; no lack of care. The only expense into which I went with some extravagance was for the purchase of mathematical and geometrical books for our little son: There is nothing that I do not expect of him.

That little son was the great man whom you are honoring to-day. Ampère grew up in Lyons and led such a life as his father and his grandfather and kin had led before him, a life devoted to study, to earnest pursuit of the highest aims of mankind. One thing lighted along his path—the love of the young woman whom he married. He married a beautiful young lady as poor as he was, and they led a happy life. It was very touching to read the letters exchanged between them. Such admiration and respect, such tenderness was exchanged between these two beings who were soon to be divided by death. He always wrote to her as "My benefactress" and she always wrote to him as "My son." She was ill when she was twenty and she said, "Illness ages me, and I consider you as my son who will survive me." He continued alone that life of hard disinterested work in poverty, which is one of the noblest of lives one can lead. So poor at first. I was reminded of it just now in looking at some samples of the writing of the great Ampère. There are letters from his wife in which she advised him not to write so big and to spare paper. He was so happy until his wife died, then he ceased to be happy. And in after life when he was at the height of his glory, recollecting those days, he said, "Now my life is all the same. It is made of rings and rings which go one into another—gray rings of sadness when I work and of sadness when I rest."

He lived an honorable life and as a man of duty he worked. What he did is noted in this city, better than anywhere else. His great discoveries in electricity and electro-dynamics have put him at the head of science, and these discoveries were the greatest which had been made in electric science since the days of Franklin.

PRESIDENT ROOSEVELT ON WATERWAY IMPROVEMENTS.*

Action should be begun forthwith, during the present session of the Congress, for the improvement of our inland waterways—action which will result in giving us not only navigable but navigated rivers. We have spent hundreds of millions of dollars upon these waterways, yet the traffic on nearly all of them is steadily declining. This condition is the direct result of the absence of any comprehensive and far-seeing plan of waterway improvement. Obviously we cannot continue thus to expend the revenues of the government without return. It is poor business to spend money for inland navigation unless we get it.

Inquiry into the condition of the Mississippi and its principal tributaries reveals very many instances of the utter waste caused by the methods which have hitherto obtained for the so-called "improvement" of navigation. A striking instance is supplied by the "improvement" of the Ohio, which, begun in 1824, was continued under a single plan for half a century. In 1875 a new plan was adopted and followed for a quarter of a century. In 1902 still a different plan was adopted, and has since been pursued at a rate which only promises a navigable river in from twenty to one hundred years longer.

Such short-sighted, vacillating and futile methods are accompanied by decreasing water-borne commerce and increasing traffic congestion on land, by increasing floods, and by the waste of public money. The remedy lies in abandoning the methods which have so signally failed and adopting new ones in keeping with the needs and demands of our people.

In a report on a measure introduced at the first session of the present Congress the Secretary of War said: "The chief defect in the methods hitherto pursued lies in the absence of executive authority for originating comprehensive plans covering the country or natural divisions thereof."

In this opinion I heartily concur. The present methods not only fail to give us inland navigation, but they are injurious to the army as well. What is virtually a permanent detail of the corps of engineers to civilian duty necessarily impairs the efficiency of our military establishment. The military engineers have undoubtedly done efficient work in actual construction, but they are necessarily unsuited by their training and traditions to take the broad view, and to gather and transmit to the Congress the commercial and industrial information and forecasts upon which waterway improvement must always so largely rest.

Furthermore, they have failed to grasp the great underlying fact that every stream is a unit from its source to its mouth, and that all its uses are interdependent. Prominent officers of the engineer corps have recently even gone so far as to assert in print that waterways are not dependent upon the conservation of the forests about their headwaters. This position is opposed to all the recent work of the scientific bureaus of the government and to the general experience of mankind. A physician who disbelieved in vaccination would not be the right man to handle an epidemic of smallpox, nor should we leave a doctor skeptical about the transmission of yellow fever by the stegomyia mosquito in charge of sanitation at Havana or Panama. So with the improvement of our rivers; it is no longer wise or safe to leave this great work in the hands of men who fail to grasp the essential relations between navigation and general development and to assimilate and use the central facts about our streams.

Until the work of river improvement is undertaken in a modern way it cannot have results that will meet the needs of this modern nation. These needs should be met without further dilly-dallying or delay. The plan which promises the best and quickest results is that of a permanent commission authorized to co-ordinate the work of all the government departments relating to waterways, and to frame and supervise the execution of a comprehensive plan. Under such a commission the actual work of construction might be [illegible] to the reclamation service, or to the military [illegible] with a sufficient number of civilians [illegible] work in time of war; or it might [illegible] tween the reclamation service and the [illegible] neers. Funds should be provided from [illegible] if it is deemed wise—otherwise from the [illegible] The essential thing is that the work sh[illegible] under the best possible plan and with t[illegible] delay. We should have a new type of [illegible] organization for planning and directing [illegible] for playing with our waterways is past [illegible] demands results.

*Extract from the President's Message to Congress.

HOW LONG WILL THE COAL MEASURES [illegible] WESTERN PENNSYLVANIA LAST?*

It was formerly supposed that the sever[illegible] formations of the Appalachian region would hold [illegible] of commercial value over the entire field. Your s[illegible] pointed out many years ago that this was a grav[illegible] take. I have personally examined the rock mater[illegible] brought up by the sand pump, while the drill was pa[illegible] through the Allegheny beds in several wells from [illegible] region of Pittsburg southwestward across western Pennsylvania, West Virginia and southeastern Ohio [illegible] on to the Big Sandy River at the Kentucky line [illegible] Wayne County, with the result that over a belt having a width of 60 miles at the Pittsburg end, and practically the same on the Big Sandy and swelling out to [illegible] miles or more near its center at the longitude of the Little Kanawha River, there is practically no commercial coal, as we know that term now, in the entire Allegheny series. The effect of this barren zone on West Virginia's productive coal area is to reduce it from 231,000,000,000 tons, as recently estimated by M. R. Campbell, of the United States Geological Survey, to about 60,000,000,000 tons. It is quite certain that Pennsylvania will not furnish more than 40,000,000,000 tons, and Ohio probably not more than 25,000,000,000 tons of commercial bituminous coal.

This shortage in coal brings to the citizens of the Pittsburg region, the present manufacturing center of the world, the most serious problem that has ever confronted them. You have been told that you had 430,000,000,000 tons of coal in your mines and that it would suffice for 150 to 200 years, while the truth is you have only one-third of that amount, and with the present wasteful mining methods it will last only 50 years.

The same causes will, in approximately that time, exhaust all of the cheaply mined thin veins in the Allegheny series of Pennsylvania, Ohio and northwestern West Virginia, and Pittsburg's industries will have entered upon expensive methods of mining coal by deep shafts to beds of inferior quality of only 2 ft. in thickness and of attempting to recover at great expense the many millions of tons of good fuel already left in the pillars and roofs and bottoms of long-abandoned mines. This is no fairy story. It is as sure to come in 50 years as that the sun will rise to-morrow.

The quantity of natural gas, the best of all fuels, which western Pennsylvania has wasted from the many thousands of wells drilled within her borders, vastly exceeds in value all the petroleum she has ever produced. Not satisfied with thus despoiling your own commonwealth of its most precious fuel possessions, some of your most powerful corporations, with headquarters in Pittsburg, have been the principal agents in wasting unnumbered billions of cubic feet of this precious fuel in your sister states of Ohio and West Virginia. The general superintendent of one of your great gas companies told me only a few days ago that he had personal knowledge of one well in West Virginia from which 12,000,000 ft. of gas escaped daily in producing only four barrels of oil. An enormous waste of gaseous fuel is still an incident of oil production in Pennsylvania, as well as in Ohio and West Virginia, and will probably so continue until the end of the chapter, largely because a few influential citizens of Pennsylvania, Ohio, West Virginia and New York always oppose any attempt to prevent this crime against these commonwealths.

TIE CREOSOTING ON A LARGE SCALE is being undertaken by the Pennsylvania R. R. Contracts have been let for a treating plant at Mt. Union, Pa., with equipment for one 6 ft. × 130 ft. cylinder and a large storage yard for preliminary air-seasoning; the total capacity of the plant will be half a million ties per year. This is only about one-eighth the annual tie consumption of the Pennsylvanian lines east of Pittsburg, but as the treatment may be expected to increase the life of a tie from the present life of between 3 and 8 yrs. to possibly 20 yrs., the annual consumption should in time be reduced so that this one plant would supply possibly one-half the requirement. To develop the most effective forms of treatment for the various kinds of wood used, the Mt. Union plant is also being fitted with a small cylinder for experimental treatment.

*From an address by Dr. I. C. White, State Geologist of West Virginia, before the American Mining Congress.

ENGINEERING NEWS

A Journal of Civil, Mechanical, Mining and Electrical Engineering

Published every Thursday by

THE ENGINEERING NEWS PUBLISHING CO.
220 BROADWAY, NEW YORK

BRANCH OFFICES
CHICAGO: 1636 Monadnock Block
WASHINGTON, D. C.: Home Life Building
ATLANTA: Candler Building
RUDOLPH MOSSE, BERLIN AND HAMBURG, GERMANY
Z. P. MARUYA & CO., Ltd., TOKYO, JAPAN

GEORGE H. FROST, President
CHARLES WHITING BAKER, Vice-President
HARWOOD FROST, Secretary
FRANCIS W. FROST, Treasurer

ALFRED E. KORNFELD, Manager
EDWIN HUNT FROST, Ass't Manager

CHARLES WHITING BAKER, M. N. BAKER,
E. E. R. TRATMAN, F. E. SCHMITT, } Editors

SUBSCRIPTIONS

United States and Possessions, Mexico and Cuba. One Year, $5.00.
Canada, $7.00 a Year.
Foreign Countries, Regular (Thick Paper) Edition, One Year, $9.00. (£1-18-0.), 45 Francs or 37 Marks.
Foreign Countries, Thin Paper Edition (Construction News Supplement Omitted), $7.00. 29 Shillings, 35 Francs or 29 Marks.
Remit directly to our office.
Pay no money to canvassers for subscriptions.
Remit by Post-Office or Express Money Order, Draft on New York or London, or by Registered Letter.
Notice of change of address should reach us one week in advance of removal. The old as well as the new address should be sent.
Subscriptions cannot be dated to commence with past issues.
All subscriptions commence with current issue and back numbers can be supplied only by special order.
Receipts for Subscriptions will not be sent unless requested, the changing of the expiration number being considered sufficient. The number on the address label indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year. 52-7 means the 52d week or December 26, 1907.

ADVERTISING

"Contract": Rates furnished on application.
"For Sale": $1.50 per inch.
"Proposal": $2.40 per inch.
"Want": See "Want" Pages.
Copy for regular, or "Contract," Advertisements should be received at least ten days before publication; "For Sale" and "Situations Wanted" Advertisements by Monday, and "Proposal" and "Situations Open" Advertisements by 9 A. M. Wednesday.

Entered at the New York Post-Office as Second-Class Matter.

An apt illustration of the value of derailing switches to protect bridge and crossing signals appears in a recent accident reported by the Interstate Commerce Commission in its Accident Bulletin 28 (April-June, 1908). The concise report reads:

> Ran off the rail at approach to drawbridge, 10 p. m. Signal light was extinguished, the filament of an electric lamp having been burned out. Engineman said he was deceived by a green light on the draw. This light, displayed for the benefit of boats in the river, turns with the draw, and the draw had not been opened. (Four persons injured; $400 damage to engine, cars and roadway.)

There was no forgetfulness or disobedience on the part of the engineman, and yet a disastrous wreck might have occurred if the derail had not been there to prevent it. The few ultra-conservative railway managers who still close their minds to the importance of derailing switches may read a lesson in this relatively trivial accident. Incidentally the accident again emphasizes the vital necessity of removing all confusing or conflicting lights from the neighborhood of railway signals. In this case, for instance, it was clear error to place the green navigation signal in such a position that the engineman could see it and mistake it for a railway "clear" signal.

The absurd attempts to force the re-burning of ashes upon the firemen in the New York City school buildings have already been pointed out in this journal.* The scheme has ended as all schemes to get something from nothing always end; and its formal abandonment by the Board of Education was announced a few weeks ago. The scheme appears to have originated with the Committee on Supplies and the Committee on the Care of School Buildings. While the orders were signed by the present Supervisor of Janitors, we understand that his acquiescence was compulsory and he never had the slightest faith in the scheme. He took the proper means to put an end to the scheme, however, by undertaking an energetic investigation of the boiler plants in the New York City school buildings. It was found that the great saving in fuel claimed for the ash-burning scheme did not really exist, and the boiler repair bill was increased. The cooler ends of boiler tubes were clogged and the steaming qualities of the boilers were impaired. The boilers appear to have suffered excessive corrosion while idle, although there seems to have been no very active deterioration while the boilers were kept hot.

It is quite true that a great deal of unburned coal has gone into the ash pit in the past; but the remedy for this waste is not in trying to burn the ashes over again with oxalic acid or any other nostrum, but in training the firing force in proper management of these boilers to prevent such waste.

Under the system now in operation, the firemen are being more closely examined as to their practical ability and instruction clubs have been organized. If coal is lost through the grates, the ashes are now raked or screened to recover the unburned fuel. Running boilers "by their dampers" is being insisted on. Firemen, engine tenders and janitors are required to present regular reports on the condition of their plants.

*Engineering News, May 14, and July 16, 1908.

After all, the Blackwell's Island Bridge is vindicated. A new discovery in bridge stresses has been made. The puerile calculations of engineers are set one side by a Nature fak—beg pardon, by a remarkable display of ornithological intelligence which proves conclusively that the much-maligned masterpiece of New York's Department of Bridges is safe. The great discovery is featured under display headlines by New York's most consciously-virtuous newspaper. We quote as follows:

BIRDS ON BIG BRIDGE VOUCH ITS STRENGTH.

Flocks of Pigeons, Swallows, and Ducks Roost Nightly on Queensboro Structure.

WOULDN'T IF IT WAS WEAK.

This Is According to Kipling and Others Familiar With Bridges.

An unexpected use is being made of the new Queensboro Bridge across the East River by thousands of migratory birds and hundreds of pigeons, which spend the night in the sheltered nooks in the lower deck of the structure. The bridge workers say that in the early morning hours the big cantilever is simply alive with birds of many varieties.

Edward E. Sinclair, an engineer on the bridge, said yesterday:

"I have been bridge building for twenty years, but never before saw so many birds and so many kinds of them gather together on a bridge as are now at night on the Queensboro Bridge.

Kipling, in his 'Bridge Builders' points out that whenever numbers of birds gather on a bridge in process of building or nearly completed, it is an indication that the structure will stand all tests. This has also been my experience.

I built a bridge in Iowa several years ago, and flocks of birds strangely made their home on it. That bridge, too, was criticized, but it is standing to-day and has done twice the work contemplated when it was built.

Another bridge whose stability was questioned, to which thousands of birds flocked, was one built across the Missouri River by the Atchison, Topeka & Santa Fe Railroad, and it is doing great work to-day. Many of my associates in bridge building have noticed this same instinct of birds. Ornithologists say that birds in large flocks will not settle on a weak structure."

Is it strange that the public is mystified and hardly knows whether the engineering profession is trustworthy or not, when prominent newspapers publish such tommyrot as the above and credit it to an *engineer*!

SHALL THE UNITED STATES BORROW MONEY FOR WATERWAY IMPROVEMENTS?

Three thousand men of prominence gathered from all parts of the United States at the National Capitol to urge upon the Government a radical extension of the work of waterway improvement. That is the spectacle that was seen at Washington last week, and it is one that rightly commands public attention. The badges worn by the delegates bore the motto: "Advocating a policy, not a project." Local organizations have for years been agitating for waterway improvement work in this or that or the other section of the country; but the convention at Washington last week was to advocate a policy on the part of the Federal Government which will provide funds for all these local projects. That is the real translation of the phrase, "comprehensive system of improvements," so frequently used by the speakers at the convention.

And what is this policy which the convention urges upon the country? As defined in the resolutions adopted by the convention at its close, it is that the nation should issue bonds for half a billion dollars to be expended upon waterway improvements. It is that Congress should authorize the expenditure of this huge sum on waterway works and leave to some other body the division of this sum between different parts of the country and different waterways and harbors.

We believe that this great waterways movement has much in it of promise, but it contains also elements of serious danger. That our federal waterways policy can be radically revised with great advantage to the country, Engineering News has for many years urged; but on the other hand, we are in emphatic accord with Speaker Cannon in his appeal to the convention for a "safe and sane" treatment of this great question. With all the shortcomings of Congress, it is fortunate that the national finances are in its hands rather than the hands of the delegates to the recent Rivers and Harbors Convention. It was only too evident that some of the irresponsible leaders in the waterways movement would land the nation in bankruptcy in short order, were the authority placed in their hands.

The convention at Washington last week was made up doubtless of high-class men, representing states, cities, and commercial organizations; yet it lacked the element of *responsibility*. It cost these excellent men nothing to fall in with the popular tide and join the chorus of cheers for "the old flag and an appropriation." It is a very different matter, however, with the legislative and executive officers of Government. They are responsible to the voters. They realize that the long-established policy of paying off the national debt ought not to be lightly reversed, because of a seeming wave of public opinion.

We say *seeming* wave of public opinion because it is altogether probable that the bonding policy advocated by the Rivers and Harbors Congress would be condemned by the sober and conservative opinion of the nation as a whole. Manufactured public opinion, such as the waterways enthusiasts represent, is one thing and the real sober second thought of the masses of the people is quite another.

The policy of the Nation ever since the Civil War has been to pay off the public debt as rapidly as possible. It is unthinkable that that wise and conservative policy should be reversed in response to a set of resolutions adopted by a mass meeting in a Washington hotel. There are many reasons why the proposition to issue bonds to pay for waterways or other national public works should be condemned.

It is said that the burden of paying for works of permanent improvement ought to be passed along to future generations, but the fact is we are already doing this on an enormous scale. The debts of cities and towns and counties are increasing faster than population or wealth, and, if anything, we are already overdoing the policy of shifting the debt-paying burden to the shoulders of those who are to come after us.

And at the same time, we are rapidly using up and wasting with a prodigal hand those natural resources on which our prosperity depends, and which ought to be made to produce a revenue that would take care of these public burdens. At the very same time that the Rivers and Harbors Congress met in Washington, there was in session there the National Conservation Conference—a body whose object is to preserve so far as possible, for the generations which are to come after, some part of the great natural wealth with which this country is endowed. Public opinion has unanimously approved this principle of conservation, and it is a serious

transgression of this principle to unload on future generations the burdens which the present generation is well able to bear.

Again, the issuance of public bonds to pay for the construction of transportation lines has been found by experience to be exceedingly dangerous. The plan has been tried by state after state and city after city, and by the National Government itself, and almost without exception the results of bond issues for public improvements of this class have been disastrous.

The reason for this unfortunate outcome may be easily seen. So long as people have to pay as they go, and every appropriation for public improvements is reflected by an increase in the tax rate, so long is there an automatic safeguard against extravagance, and against embarkation in unprofitable schemes. But when money is raised by bond issues, there is no such safeguard. There is always strong pressure to undertake enterprises which are unsound and unwarranted. This very waterways convention, which declared for this half-billion dollar bond issue, proved by its own proceedings its unreliability to guide the nation to wise and beneficial action in this matter. The papers before the convention were all of one sort—to boom the waterways movement. The most extravagant statements were put forward by the speakers and passed without a hint of doubt or criticism. Of real serious discussion pro and con, there was practically none, if we except the able and fearless speech of Speaker Cannon.

Much of the current propaganda on which the waterways agitation is based is wholly fallacious. A good illustration is the oft-repeated statement that water transportation is one-fourth, or one-sixth, or one-eighth as expensive as rail transportation. The fact is, of course, as every expert in transportation worthy of the name knows, that no one can say that water transportation per se is cheaper than rail transportation. Actually, the cost of transportation on any given route depends directly upon the volume of traffic upon it; and, while waterway transportation on the ocean or the Great Lakes is undoubtedly cheaper than transportation by rail, there are many lines of water transportation where the total cost is in excess of the cost of rail carriage.

It has been currently reported in the newspapers that President Roosevelt and President-elect Taft were each committed to a government bond issue for waterways improvement. The real fact is that such approval as they may have expressed of such a national policy has been carefully qualified with the proviso that such bond issues would be permissible if it were not found feasible to provide the money in other ways. We may confidently hope, therefore, that both in the legislative and executive branches of the government due conservatism will prevail before any radical action on the bond scheme of the Rivers and Harbors Congress will be taken.

As we have said above, there is good ground for hoping that radical revision of the Nation's policy on waterways improvements may be made, and the most hopeful direction for improvement is undoubtedly that recommended by the Secretary of War—to place the *planning* of such improvements on the proper basis. It is in that matter that our present system—or lack of system—is farthest astray. Senator Newlands, of the Inland Waterways Commission, is the author of a pending bill which provides for a permanent Inland Waterways Commission, but provides also for a blanket bond issue to be issued by authority of the Commission from time to time without resort to Congress. It seems to us that this is an unfortunate feature of Senator Newlands' bill, and one which will almost certainly ensure its defeat. We heartily endorse the creation of a Waterways Commission with broad powers to originate plans, make surveys and investigations and report to the Government as to what projects it is worth while to undertake. If such a commission were properly constituted, its recommendations would carry such public weight that their approval by Congress could be counted on.

A SCIENTIFIC SCHEME FOR SEWAGE DISPOSAL BY DILUTION IN NEW YORK HARBOR.

The most scientific plan for sewage disposal by dilution thus far proposed in the history of sanitation is now before the New York Harbor Line Board, on reference from the U. S. War Department. It involves a carefully planned system of dispersal and diffusion into and by the vast tidal flow of New York Harbor. It is designed to take care of the screened and more or less thoroughly settled sewage of a portion of New Jersey, officially named the Passaic Valley Sewerage District, which includes Paterson, Passaic, Newark and other municipalities the untreated sewage of which now reaches New York Bay via the Passaic River, Newark Bay and Kill von Kull.

Inasmuch as Greater New York, Jersey City, Hoboken and lesser communities, making up a population of four to five million, are now discharging their sewage directly into New York Harbor, generally in the most happy-go-lucky fashion, it might be supposed that New York City would welcome the attempt of the Passaic Valley Sewerage Commission and its engineers to carry out a well-considered plan of sewage disposal. But the history of sanitation is replete with incidents which show that individuals and communities which cannot be aroused to serious nuisances of their own origin will speedily become horrified at fancied evils incident to scientifically planned measures to prevent, before it occurs, a like nuisance on the part of their neighbors. And so, true to history and tradition, such of the public bodies, newspapers and individuals of New York City as have taken notice of the Passaic sewerage plan have unanimously condemned and opposed it, out of hand, as was very evident at the two-day hearing of the Harbor Line Board in New York City last week.

If we understand rightly the jurisdiction of the War Department over sewage discharge it extends only to matters concerning navigation. These include, primarily, shoaling of navigable channels by sewage deposits and, of secondary and relatively minor importance, perhaps they also include floating sewage matters, which might be offensive to the eye or nose.

In the case of the Passaic sewer outlet (see report of hearing elsewhere in this issue) it is proposed to screen out all visible suspended matters and to further reduce the suspended substances by screening. The degree of clarification to be aimed for has not been decided by the commission, but has been left to the government authorities. The unique and commendable feature of the plan, a feature which promises to be a great advance step in sewage disposal by dilution, is the multiple discharge of the screened and settled sewage, in a horizontal rather than a vertical direction, through as many branch outlets as may be deemed necessary so to diffuse the sewage through and by the tidal current as to make certain its final oxidation without offence, at the same time so widely distributing any remaining solids as to prevent shoaling.

It may be noted in passing to quite another phase of the subject that almost without exception the great seaports of the world rely upon dilution rather than sewage farms or septic tanks or filters for sewage disposal—that is water and not land is the sewage disposal medium for great seaports. The notable exceptions to this rule are what may be termed somewhat anomalously, but yet truly, inland seaports, like London, Glasgow and Manchester, where the volume of water near at hand is altogether inadequate for dilution. But even in such cases it is clarification rather than purification that is attempted.

Most of the New York opposition to the Passaic Valley or New Jersey scheme, as exhibited at the recent hearing, was based on existing pollution for which New York and New York alone is responsible. If the Passaic Valley scheme, with its relatively far remote and improbable dangers of injury to New York harbor, serves to arouse New York to its own need for some such scientific plan of sewage treatment as is proposed for the New Jersey communities, the latter can perhaps afford to bear with equanimity the unjust slurs cast upon it by representatives of New York. From these slurs one would think that the Passaic Sewerage Commission proposed to increase rather than diminish the antiquated methods [illegible] lack of methods of sewage disposal in [illegible] in the greater metropolitan district, and [illegible] in any event New York City had a patent monopoly on the use of the New York Bay for sewage disposal.

Of course we realize that New Jersey communities would not be justified in adopting New York Harbor by an ill-considered scheme of sewage disposal simply because New York City is now discharging the bulk of the sewage into the harbor wherever and however it happens to be most convenient. At the same time, it is, to say the least, quite unneighborly for New York City to oppose a scientific use of the harbor for sewage disposal purposes by other adjacent communities until it has taken some really serious and promising step to correct undoubted and growing evils due to its own utter lack of a system of sewage disposal.

We are well aware that at the hearing last week some of those in opposition to granting the permit urged refusal on the ground that New York City is taking steps for improved means of disposal. For our part, we have seen no official steps of the sort and can discern no marked inclination in that direction on the part of those responsible for the administration of the affairs of New York City. It is true that a state-created commission, or series of commissions, hampered by lack of funds and, until recently, by internal dissensions, has been investigating the pollution of New York Harbor for five years or so, and is required by law to report (again) on the subject by May, 1910. It is also true that there has been some activity in other quarters (much of it wofully misdirected, though perhaps all well intended), but nearly all this activity seems to have been due to the zeal of a mere handful of enthusiasts, acting in their private capacity, and is far from representing either an aroused public opinion or aroused municipal authorities.

By a strange chance, the hearing on the proposed outlet was scarcely over before one of the chief arguments of the opposition was largely answered from a little expected but authoritative source. Much stress was laid, at the hearing on the alleged unsatisfactory condition of Boston Harbor in the vicinity of the Moon Island outlet of the Boston sewerage system. Now comes to hand the annual report of the Massachusetts State Board of Health for 1907 with a brief special report on this very matter, made by legislative direction. The conclusion of this special report is that

> the Board sees no present necessity for the adoption of means for the prevention of the further pollution of the harbor by the discharge of sewage at Moon Island or at either of the other main outlets.

Although thus far we have confined our remarks almost wholly to the possible obstruction of navigation by the discharge of sewage into New York Harbor, perhaps the greater part of the time taken up by the hearing was occupied by arguments and assertions designed to show that to allow the discharge of sewage beneath some 40 ft. of salt water, remote from shore, would be a menace to the public health.

Now the merest tyro in sanitation ought to know that, oysters aside, the danger to the public health from sewage so discharged and diluted would be so remote as to deserve no consideration until a hundred far worse dangers had been removed, and an infant in economics could see that the oyster industry in New York Harbor could be bought out at a handsome profit rather than allow it to interfere with any large, well-considered scheme of sewage disposal. As for the oyster industry, it is questionable whether New York Harbor is a proper place for it anyway, quite regardless of any system of sewage disposal likely to be adopted in the next century.

The real danger to the public health from sewage disposal, so far as a danger exists in New York Harbor, lurks in the sewage to be found

in the nooks and recesses of the water front and in enclosed waters like Gowanus Canal and Newtown Creek, and is due to the haphazard means of disposal employed by New York City. Even this danger seems to have been exaggerated; but some danger there may be and much offense to eye and nose there unquestionably is.

Such danger and such undoubted offense as exist along the water front affords no valid argument against but rather one for the adoption of a scientific plan for sewage disposal by dilution in New York Harbor. New York should welcome, not oppose, such a plan as the Passaic Valley Sewerage Commission proposes, subject only to iron-clad assurances that the screening, settling and dispensing or diffusing works shall be so built, maintained and, if necessary as time goes on, so altered, as to prevent a nuisance at the surface or serious obstructions at the bottom of the harbor.

To return, in conclusion, to public health questions. We maintain, as we have more than once before, that aside from relatively minor and easily remedied pollution, the relation of tide-water sewage disposal to the health of New York City is so remote as to be unworthy of consideration until many far more vital health problems have been met and solved. The cost of sewage purification, real purification, to five million of people now within and the ten million soon to be within the greater metropolitan district of New York and New Jersey, naturally tributary to New York Harbor and its immediately connecting waters, would be simply appalling, and it would bring no benefits that would begin to compare with the expense. If Newark and Paterson ought to be compelled to purify their sewage in the interest of either health or navigation, before discharging it into New York Harbor, so ought Greater New York, Jersey City and Hoboken. Proper systems of sewage disposal by dilution can and should serve all these communities for years to come, until a dozen undertakings, each far more important to health and to commerce than radical means of sewage disposal, shall have been carried out in each of the several cities. This stern fact, however, is no argument against but is a reason for careful investigation to determine just what improvements in sewage disposal are needed in each section of the great maritime metropolis of America. For the Passaic Valley Sewerage District those studies have already been so extended and satisfactory, with promised results so far in advance of anything yet proposed for the remainder of the metropolitan district, that the Passaic District should be permitted to go on with its much-needed improvement, which has already been delayed for a dozen years by unreasonable opposition from almost every conceivable quarter.

LETTERS TO THE EDITOR.

The Question of River Protection.

Sir: Referring to the two letters on "River Bank Protection" in your issue of Dec. 10, p. 647, by Mr. Chas. H. Miller, of the Missouri Pacific Ry. Co., and myself, I do not feel at liberty to ask for further space for argument. But I hope they will serve their purpose in bringing out discussions on the subject from more eminent writers, so that finally some definite conclusion may be arrived at as to what is the best method of bank protection, economy and permanence considered. While this is only a small part of general river improvement, it is a most important part, as in this way vast benefit is derived by railroads, municipalities and individuals, along with the improvement of navigation.

The entire country seems to be so fully awake to the necessity of the improvement of the inland waterways that methods of improvement should be worked out in their every detail, so that the vast amount of money that will be expended in this manner in the near future will be expended to the very best advantage to all concerned, and not be wasted.

Yours very truly,

W. R. DeWitt,
U. S. Asst. Engineer.

Kansas City, Mo., Dec. 12, 1908.

A Proposed Department of Public Works.

Sir: In your issue of Nov. 26 was an article entitled "A Proposed Increase in the Corps of Engineers." In this article you take exception to the method of the proposed increase. Why do you not take exception to the increase itself? True—you have hinted at such exception in the last paragraph.

Is it not a fact that the present federal organizations affiliated with our public works are a conglomerate absurdity? The present organizations are a patchwork growth. Everyone acquainted with the engineering work which has been done by our government knows that it has been done in a most uneconomical manner, due to a multiplicity of heads and lack of sympathy between the chiefs and the subordinates. Taking the cause, the effects follow naturally, viz.: duplication of work, insufficient work, lack of esprit de corps; poor work by competent men whose ambition is dying for lack of recognition or being smothered by plagiarism and kindred evils; poor work by incompetent or dishonest men who are in the job for the money and are willing to risk the chances of discovery under inefficient inspection.

The present organization, in most cases, for carrying on the federal public works are a makeshift. When the works were begun, but few men were needed and their present magnitude was undreamed of. Those conditions have changed. The expenditures have increased from thousands to millions, and to many millions.

A Department of Public Works is the only logical way of handling this work today, and with such a department there would be no need of an increase in the Engineer Corps of the Army unless so many were transferred from army to civilian rank as to deplete the present corps.

Since writing the above, the President's message has been published. It contains a few sentences which are pertinent to this subject. The President recommends a Commission (permanent in so far as possible) to carry on the river and harbor work. This would be a step far in advance of the present method, but why not go the limit and put this Commission under a departmental head which also should have charge of the other public improvements and kindred work.

The immense volume of work and expenditure is worthy of a department. The many bureaus now doing surveying, planning, estimating and constructing would thus be brought into harmonious relation; the duplication of much work stopped; the valuable interchange of ideas and results secured, definite policies formulated on a much broader basis and the desires of States learned and their co-operation secured.

By making the members of such commission as the President proposes, permanent (dependent upon fitness) and with proper organizations thereunder, the greatest incentive for the best work would be present and the personnel of every bureau would be brought to the highest point.

Unless these works, river and harbor, reclamation, buildings, surveys of nearly all kinds, etc., are put under a Cabinet officer, whose chief care they are, they will never command the prestige, hold the power and have the authority necessary to do things.

Yours respectfully,

Theron M. Ripley.

Fulton, N. Y., Dec. 11, 1908.

[In comment on the above letter we may suggest that *all* work carried on by the Government is public work. Further, engineering work, of one sort or other, is being carried on by nearly every one of the Government departments. We believe this engineering work is properly thus distributed and that the proposal often made, to concentrate all the Government engineering work in one department is really based on a fallacy. Very likely some reorganization and rearrangement of the various bureaus at Washington could be made to advantage; but the results aimed at and not the means used should govern in making any rearrangement. The mere fact that two different bureaus are making surveys or are carrying on construction work is no reason for their amalgamation.—Ed.]

The Minneapolis Building Department Tests of Plain and Reinforced Concrete Columns.

Sir: In your issue of Dec. 3, 1908, you give results of a series of tests on plain concrete and on reinforced-concrete columns made for the Department of Buildings of Minneapolis, Minn. In commenting on these you say:

The results of the tests are rather disappointing in that they are sufficiently erratic to make impossible any clear-cut conclusions. * * * It will be seen that there is no recognizable relation between ultimate strength and the type or amount of reinforcement.

In the light of the design of these columns I think the second part of this quotation is the most clear-cut and logical conclusion that could be arrived at.

In my opinion these tests are of exceptional value. In fact, the lesson they teach is of such vital importance that every reinforced-concrete designer should study them. They throw a clear light on some failures of concrete steel buildings.

The test marked A was a 9 × 9-in. column 9 ft. 6 ins. long with 10 longitudinal round rods ½ in. in diameter and 1½ × 3-16-in. circular bands (having two ½-in. rivets in the splice) spaced 4 ins. apart, the circles being 7 ins. in diameter. It carried an ultimate load of 130,000 lbs.

I quote from an authority:

The compressive resistance of a hooped member *exceeds* (italics are mine) the sum of the following three elements: (1) The compressive resistance of the concrete without reinforcement. (2) The compressive resistance of the longitudinal rods stressed to their elastic limit. (3) The compressive resistance which would have been produced by the imaginary longitudinals at the elastic limit of the hooping metal, the volume of the imaginary longitudinals being taken as 2.4 times that of the hooping metal.

Applying this to the above case: (1) is 2,000 × 81 = 162,000 lbs.; (2) is 40,000 × 10 × .1963 = 78,520; (3) is 74,200 (using net area of band). The compressive resistance of the column should then *exceed* 311,120 lbs. *It was much less than half of this.*

It will be urged that this particular column had a bad batch of concrete at the break. Should it be possible that a little bad concrete will destroy more than one-half of the strength of a column?

Column A1 was identical in all respects except that it had only 4 longitudinal rods. It should have had a strength exceeding 267,600 lbs. Its actual ultimate strength was 156,510.

The lesson from these tests is simply this: Longitudinal rods in a concrete column do not reinforce it, and hoops add only an indifferent strength unless they are spaced close enough to stiffen the longitudinal rods. I have pointed out these facts before in articles and letters and in my book "Concrete." It was proven by tests made at the Illinois Experiment Station that longitudinal rods *reduce* by a large percentage the ultimate strength of concrete-steel columns, in spite of the fact that authorities are almost a unit in stating the exact opposite of this fact. As you point out, 5 of the 17 tests on reinforced-concrete columns made at Minneapolis stood less ultimate loads than the plain concrete columns.

The "common theory" of reinforced-concrete columns is based on an assumption that is not true, namely: the steel and concrete are initially unstressed. This is not a possible condition, because the concrete shrinks and puts the rods in compression. Added load quickly puts these rods in excessive compression with the result that they buckle and break out the concrete, and the strength of the column is, as a rule, less than a plain concrete column.

I asked an authority for a defense of this common theory. His reply was: "A defense of the theory is not required at this time." He is right. All the theory needs is to be expunged from all books on the subject and forgotten.

Yours very truly,

Edward Godfrey.

Monongahela Bank Building, Pittsburg, Pa., Dec. 9, 1908.

Methods of Stress Calculation for the Blackwell's Island Bridge.

Sir: Just something about the expert reports on the Queensboro bridge, since that question is of so great importance and general interest, and especially about the method published in your issue of Nov. 19 for calculating stresses in that structure. There's nothing wrong in it, to be sure, but nothing true either in the assertion that a "simplification of the formulas securing notable economy of labor and time" was attained by Mr. Hudson, who did this work for Boller & Hodge. The method may safely be called prehistoric, and I pity the draftsmen in the office who had to make such tedious calculations. The method was good in the times of Grashof and Navier, when continuous beams were figured by cutting them into statically-determinate parts and putting tangents and deflections equal. Since then we have had Mohr, Maxwell, Castigliano and they gave us more elegant methods.

This as to the method; as to the alleged simplifications, these are altogether illusory and if the calculations were really performed as described in your columns we can safely express the opinion that the engineer in charge was not the right man in the right place.

The rocker stresses are put:

$$L = \frac{(D_a - D_{b1})\ (d_2 + d_4) + (D_{br} - D_c)\ d_{20}}{(d_1 + d_2)\ (d_3 + d_4) - d^2_{20}}$$

$$R = \frac{(D_c - D_{br})\ (d_1 + d_3) + (D_{b1} - D_a)\ d_{20}}{(d_1 + d_3)\ (d_2 + d_4) - d^2_{20}}$$

or in simpler notation:

$$L = \frac{(D_a - D_{b1})\ a + (D_{br} - D_c)\ b}{c} \quad \ldots\ldots\ldots(1)$$

$$R = \frac{(D_c - D_{br})\ d + (D_{b1} - D_a)\ b}{c} \quad \ldots\ldots\ldots(2)$$

The so-called simplification now consists in taking these formulas apart by putting alternately D_a, D_{b1}, D_{br} and D_c equal to zero, getting six simple equations:

$$L = MD_a;\ R = -ND_a$$
$$L = -MD_{b1} + ND_{br};\ R = ND_{b1} - GD_{br} \quad \ldots\ldots(3)$$
$$L = -ND_c;\ R = GD_c.$$

These of course have to be added anyway in case loads are on all three parts and in case they are not (1) and (2) become simple too. It is going in a circle; where the labor-saving device is I can't comprehend. Just as much work to figure out the six equations and add them as to figure out two equations a little longer.

But the incredible part comes now: It is stated that a

unit weight was placed at the first panel point, then statical stresses calculated, then deflections computed, that is D_a, D_{b1}, D_{b2} and D_c [only D_a, the other three being zero.—Ed.], then L and R computed. *This process was repeated for every panel point.* That is hardly credible, would be really prehistoric! Of course the way to proceed was to take the curves of deflection belonging to d_1, d_2, d_3 and d_4, which are the influence lines for deflection in those points [at the rockers—Ed.] for a unit load. Just think of figuring every deflection anew!

But even at that the method is too tedious and old-timed. We still have to figure out L and R out of (1) and (2). The way is too long, and consequently besides the more labor (I mean without this ridiculous calculation of every deflection) a greater error enters into the final result.

The method to figure this bridge is the following: Take away the supports C and D (or B and E), which makes the structure statically determined, and apply alternately a unit load at C and D. Draw with the chord-angle-variations $(-\Delta'\delta_1)$, $(-\Delta'\delta_2)$, etc., as loads a chord polygon A_o L F_o with arbitrary polar distance (construction of Müller-Breslau) which may cut the vertical through D in J and verticals through the end supports in A_o and F_o. Then draw a second polygon with loads $(-\Delta''\delta_1)$, $(-\Delta''\delta_2)$, etc., (chord-angle variations belonging to load $X'' = 1$) with such polar distance that it goes through the points A_o J F_o. The area between the two lines is the influence plane for X', and $X' = P \frac{y}{c} \frac{1}{c}$ being the multiplier. Same construction for influence plane for X''. There is no "cluster" of influence lines whatever. This, and not the one used, is the method applied nowadays on a continuous beam doubly statically indeterminate.

Conclusion: The published method bears evidence that such problems are out of the way of the consulting engineer. Messrs. Boller & Hodge and Hudson are engineers of reputation, but they are no experts in applied mechanics. Now this cannot be expected from an engineer. Let us be frank about our mathematical training. Every civil engineer nowadays has had his analysis, his theoretical and applied mechanics and many were very clever at differential equations or problems about the equations of Lagrange or Euler integrals or the theory of errors. But I would have to do some serious thinking about the problems solved in a jiffy in those polytechnic years. Applied mechanics are better preserved since they are used once in a while, but experts can only be people who make their life work out of it, and such are only the professors of applied mechanics in the engineering schools, and for a problem of the highest order as this big so-many-million-dollar bridge is we have to pick out a specialist of the highest order. If I remember well, Prof. Melan in Prague was consulted on the Williamsburg bridge. Why not take Müller-Breslau of Berlin or Rabut of Paris on this?

Take a consulting engineer, and he gives it to another, and the result is poor.

So much about the report. Concerning the stupendous conclusions I think your attack on the Department of Bridges was very mild. The best thing that can be said about the achievement of those great engineers is what Talleyrand said about another Napoleonic error: It is worse than a mistake, it is a blunder.

Very truly yours,

A. Streiff,

Chief Eng., New Jersey Cement Constr. Co.
136 North 13th St., Newark, N. J., Nov. 27, 1908.

[We differ with the writer of the above at every point. As his remarks are more denunciatory than detailed, it may conduce to clearness if we review them briefly.

The "incredible part" of our description of the method used in analyzing the Blackwell's Island or Queensboro Bridge, if we understand the writer's meaning, is as follows. We said that after the values d_1, d_2, d_∞, d_3 and d_4 had been obtained and combined into the constants M, N and G, the next step was to find the rocker stresses due to single loads of 1 lb., placed successively at the individual panel-points; the simplified formulas, Eqs. (3) in the above letter, are used for this, and thereafter the whole work is statically determinate. To find the rocker stresses due to 1 lb. at the first panel-point, we said, the rockers were first assumed disconnected and the static stresses due to the 1-lb. load computed, therefrom the corresponding deflection D_a calculated, and the rocker stresses then computed as $L = M\ D_a$ and $R = -N\ D_a$. The writer of the above letter seems to say that this is in part a repetition of previous work, because this D_a, the deflection at rocker L, is equal to the deflection D_1 of panel-point 1 under a load of 1 lb. at rocker L, which was the condition taken in finding d_1. Assuming that D_1 was found in the previous work, the repetition of labor by calculating D_a separately is "incredible" to him. But the facts are against him.

In the first place, our statement pretended to be nothing more than a recital of the successive essential steps in the process, and by no means a definite description of the procedure employed in going through the individual steps. If in the actual computation one of these steps was abbreviated, or even virtually eliminated, by the fact that the quantities which it should give and had already been obtained under another guise, this in no way alters the logical place of the step in the entire procedure. Our statement was not meant to imply (and we think could not fairly be so interpreted) that Boller & Hodge actually computed independently each of the steps indicated, if the steps as stated by us involved any repetition. In fact, we did not say whether they did part of their work graphically or whether the whole of it was done by analytical computation, a matter bearing directly on the point criticized.

They actually did the whole work analytically, we are informed. Especially with such flat angles as are found in this structure, the accuracy of graphical work with ordinary drawing tools is quite insufficient. In an attempt to check the analytical work by graphics, it was found that the ordinary T-square and triangle were entirely inadequate to make a practical check. It was concluded that even if influence lines had been plotted for the structure, they could have been made reasonably accurate only by computing the ordinates analytically and laying out the curves by measurement. The amount of computation necessary for this would be the same as was required in Boller & Hodge's procedure, and the plotting of lines would have been simply added labor.

Even taking our statement as a literal description of the procedure there does not appear to be repetition of work at the point in question. In computing (analytically) the deflection d_1 at L, due to a load of 1 lb. at L, the deflection D_1 at panel-point 1 is not required to be found, nor is it found as an incidental result, as Mr. Streiff seems to imply; to compute this deflection D_1 at this stage involves an added amount of work exactly equal to that needed later on for computing the equivalent deflection D_a for unit load at point 1. The only item of the calculation for d_1 which can be used over again in finding either D_1 or D_a is the set of stresses caused by unit load at rocker L, and these would obviously be preserved for use because they are employed later to find the true stress increments due to the rocker stresses.

The fundamental weakness in the above letter, however, is the writer's apparent failure to understand that in a very extensive computation like that of the Blackwell's Island Bridge it is necessary that the work be split up into as many pieces of simple computation as possible. Methods of procedure *must* be fitted to this requirement. If it is inevitable that in the first stages the whole work be in the hands of one man, yet as soon as possible it should branch out into several sections which go along independently, and each of these should further branch if possible into subsidiary pieces of simple computation. A given method may be shortest and most "elegant" if carried through by one man from beginning to end, and yet be totally unusable in a very large calculation for this very reason: the impossibility of concentrating a large working force on it. There is the further objection that such a method is generally complicated, and eludes simple checks or comparisons, so that when the work is all done there is no way to make sure of its precision except a second man's going through it a second time independently. The procedure used by Boller & Hodge is preeminently free from these weaknesses. For, not only does it branch into many separate pieces of elementary computation at an early stage, but each part is of such a nature that errors reveal themselves to the trained eye almost automatically, and checking is applicable throughout.

The adjective "prehistoric" also requires notice, because it involves fundamental misconceptions. There is no royal road to stresses in a statically indeterminate structure. There is only one way, however it may be dressed up or disguised. If a structure has more supports than are necessary for stability, or more parts than suffice to make it rigid, then the forces exerted by these supernumerary parts can only be found in four steps: 1. Eliminating the extra parts, determine what effect (measured in the same terms as the constraint produced by these parts) is caused at these points by the load; generally speaking, this means that for each extra part a deflection, linear or angular, must be calculated. 2. Again eliminating the constraints, determine what effect at the point of constraint is produced by a given force; this also involves computing a deflection, and only a small part of the work necessary for this can be taken over bodily from step (1). 3. Multiply the forces assumed in step (2) by the ratio of the effect found in step (1) to the effect found in step (2), and thus obtain the forces exerted by the constraints; this is simple arithmetic for a single constraint, and simple algebra in the case of several constraints. 4. Compute the stresses caused by the forces just found (acting in the points of constraint), and add them to the stresses active in the absence of the constraints (which were probably already found in the first step); this gives the desired result.

Now, none of these four steps duplicate each other, and with the two exceptions indicated there is no repetition. Whether the rockers L and R are selected as the supernumerary parts (as was done in the calculation of this bridge) or the two middle supports (as the above letter recommends), makes no difference in the amount of labor involved. No radical alteration of the procedure is possible, and in fact "Mohr, Maxwell and Castigliano" whom Mr. Streiff cites were the very ones to establish this firmly. The only exception—and that is "prehistoric"—is the case of a structure whose constitution can be represented by an algebraic equation, as for instance the continuous solid beam of constant cross-section, or the solid arch shaped to algebraic curves. Trusses, however, lie altogether within the scope of the procedure above outlined. The only shortening of work attainable is that of reducing to a minimum the number of different loadings which must be investigated. This was accomplished in the method pursued by Boller & Hodge.

Finally, the Blackwell's Island Bridge is not at all "a problem of the highest order" in the mathematical sense as the writer of the letter implies. The whole difficulty was to arrange the procedure so as to be suitable for employing many computers, as already referred to, and this difficulty was solved to full satisfaction by the engineers, to whom the above letter refers in rather derogatory fashion.

If large structures are designed in such a way that only two or three men in the world can analyze them, or that experienced bridge engineers are unable to determine how strong they are, we had better not build them. The safety of a structure destined to carry thousands of human beings should not be entangled in a "mathematical problem of the highest order," nor removed so far from usual methods of design that only two or three expert theorists are able to reason accurately concerning it.—Ed.]

Notes and Queries.

Mr. D. S. Jones, P. O. Box 82, Ambridge, Pa., inquires if there is any case on record where vitrified brick in street paving have been taken up, turned over and replaced after the first wearing surface had been worn out. We would be glad to have any information on this subject.

A printer's error in the article "Articulated Compound Locomotives," printed in our issue of Dec. 10, p. 601, placed the table of dimensions relating to the great Erie Mallet locomotive, shown in Fig. 1, under Fig. 11, the drawing of the Santa Fe superheated-steam locomotive.

In connection with the editorial note in our issue of Dec. 3, 1908, suggesting the use of crusher dust as a surface roughener in concrete walks, a correspondent suggests the following:

Sweeping the top with an ordinary broom will produce any desired degree of roughness and will also give a uniform appearance, although it is rather hard on shoe soles.

REMINISCENCES OF A GAS ENGINE DESIGNER.*

By L. H. NASH,† M. Am. Soc. M. E.

In these short remarks I do not intend to attempt to follow the line of development of gas engines as a whole and especially not those branches of it which have been developed by many eminent engineers, because these matters have been carefully described in publications and by lectures, so that they are familiar to all gas engine engineers. My purpose is rather to present from the point of view of one of the workers the principles in which I have personally interested myself, and to trace some of these lines as they have become parts of the general art of gas engine construction.

In the early days, the gas engine was considered a device more adapted for small powers and was not classed as a serious rival of the steam engine. Its construction followed the lines of the old horizontal engine, of which the Otto is the best example, and the only deviation from this horizontal principle that I know of was the vertical Otto engine, in which the crank was above the cylinder, and in which all accumulations of oil remained in the bottom of the cylinder. I had a friend who used to spend every Saturday night cleaning up his engine in order that it might be ready for the following week's operation.

It seemed to me, therefore, absolutely essential that the cylinder be placed above the crank shaft so that all waste products could escape from the fire chamber so far as possible. That principle has now been adopted by all makers of vertical engines. Such a construction now seems obvious, and when one realizes that steam engines of this form were in common use, it seems a little surprising that the advantages of the vertical engine were so slowly recognized.

The working fluid of an internal combustion engine is gas at extremely high temperatures, and in that it differs from the steam engine. It has taken many years of careful thought to provide a structure in which these gases can be handled without danger of destroying the mechanism or of injuring its bearing surfaces; and while today all these difficulties are overcome, the need was by no means obvious to the early designers of engines, and even now, when a new man begins the construction of an engine of this class, his greatest liability to mistake lies right in this lack of appreciation of the necessity of using cooling water at every point where heat can possibly cause injury to the parts.

Naturally, in the development of a new device having such peculiar characteristics and hoped-for possibilities of economy, a great variety of expedients and of mechanism have been adopted. The process of evolution gradually eliminates many of these, and others find their uses in peculiar conditions and become standard for special work. It was natural to follow, to a large extent, the lines of the steam engine and this seems to have been the first step in the art, especially in Great Britain.

The great amount of heat ejected from a gas engine naturally led people to think of combining a gas and steam engine to utilize this waste heat. The writer once thought he had evolved a brand new idea in this line and made application for a patent upon it. The application was acted upon by the United States Patent Office and every one of the broadest claims were allowed. He had thought of riches beyond the "dream of avarice"; but in a fatal hour the examiner discovered some British patents, and not only a few, but many of them, in which it seemed as if the ingenuity of inventors had been exhausted in combining gas engines and steam engines, at least on paper. Needless to say, the dream of immense wealth passed away. But while this idea of combined steam and gas engines seemed so attractive to many, I do not know that it has ever been embodied in a commercial structure. The difficulties of carrying the thing to a conclusion seemed too great to warrant the outlay, and while to a certain extent the waste heat of the gas engine is utilized for commercial purposes, in other ways the development in this line has not been very extensive. The amount of heat that can be saved is very large, and as larger installations of gas engine power plants are used, and the cost of fuel becomes a more important factor, the cost of installing these heat saving appliances will no longer be considered prohibitive, but with small units very little has been done.

The use of gas engines for marine propulsion was one of my earliest dreams and the problem still seems only partially solved. Notwithstanding the large number of engines used in motor boats and the fact that some vessels are being equipped with gas engines, it is fair to say that the problem is today in its infancy.

Fig. 1 shows an attempt along these lines made by me 25 years ago, and not yet realized except in part. This cycle of operations, so far as I know, has never been adopted in any gas engine, and it seems to have some merit for the purpose of marine propulsion.

Referring to the figures, it will be seen that it was proposed to supply the engine with fuel, either coal or a liquid. The steam boiler was to be retained for emergency work; an independent air compressor was to furnish the means of supplying the compressed charge as required, and the engine was to operate with a cycle in which the regulation could be controlled at will without danger of shutting down from failure of its own mechanism; in other words, the starting was to be effected by external means, consisting of compressed air furnished from a reservoir or a compressor actively operated by a separate source of power. As a different application of a part of this idea, I designed a compressor driven by a gas engine cylinder instead of steam. The engine was to be double-acting and all wearing parts were to be provided with an elaborate system of water cooling for piston rods, pistons, etc. I believe this system has never been completely adopted as a whole, although many of its features are today parts of standard engines. The method of starting by compressed air is now used in all large gas engine units; but the peculiar cycle of operations I think has never been put into practice.

Notice in Fig. 2 the proposal to introduce the charge into the cylinder under pressure and then cut it off and ignite it at some point during the forward stroke of the piston. The governing would be by cut-off, by the methods usual in steam engines. The very wide range of power cards which could be obtained from a given cylinder is suggested. The engine was to be reversible like a steam engine, by the use of the usual link and eccentrics.

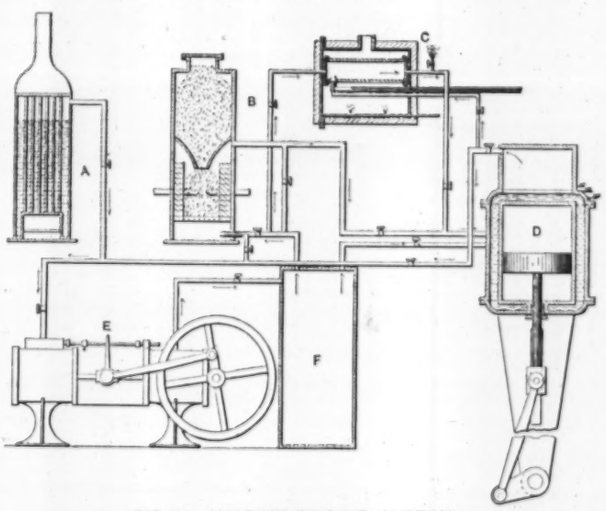


FIG. 1. MARINE ENGINE SYSTEM.
(A, steam boiler; B, coal gas producer; C, liquid fuel gas generator; D, engine; E, compressor; F, air storage tank.)

The method herein indicated of supplying the engine with charge under pressure, seems to have some merit; in fact, I look back on this old idea with considerable curiosity that some one has not used it. I still believe that the method of operation described in this old patent will give the best solution yet offered of the marine gas engine. The method of generating the gas in a generator under pressure does not seem to have been tried and may still prove of value, but taking the system as a whole, the possibility of constant operation of the engine, and its ability to reverse or start under any circumstances should make it as valuable as a steam plant, and if the apparatus for furnishing the charge is made in multiple, as is the boiler supply for a steam engine, this idea should be no less reliable in service than standard marine engines using steam.

The cost of developing engines of a large size, and especially for marine work, was far beyond the financial resources back of the writer, who was obliged to devote himself to smaller problems. The patent has expired, and the idea is left to take its place in the general evolution of the gas engine art and perhaps to suggest what might have been or may yet be. But many of its features will be found in existing engines, and if the original claims were still in force many an engine builder would be required to pay royalties today.

Economy in the use of fuel is to be secured by high initial pressure, but the use of high pressures in a cylinder requires more perfect workmanship to prevent loss by leakage of the charge, so that what may be gained in a structure theoretically may readily be lost by any defect in mechanism.

Fig. 3 shows a structure which I designed to handle very high pressures; my idea being that a plunger could be packed by the use of flexible packing, so as to be absolutely tight, where a cylinder and piston furnished with rings might fail. It will also be noticed that the connecting mechanism is made with rocking joints, which need no lubrication, the ends of the connecting rod and the bearing upon which they operate being cylindrical and made of hardened steel. Cards made from this structure demonstrated the fact that a very high degree of economy could be secured.

Two things prevented success at this time, however. In the first place the electric igniter, now in common use, was not then available, and it was necessary to use the old-fashioned flame igniter, which introduced many complications; and I was also convinced that the use of high compression would not prove a commercial success, in small units at least. When the Diesel motor was placed upon the market in small units, therefore, I watched the development with a great deal of interest to see whether I was not correct in my judgment, and the early history of the first engines introduced amply proved that it would have been a mistake for our company to continue further in this line of work.

Notwithstanding the fact that the Diesel engine has overcome these difficulties and is today a commercial success, at least in the larger sizes, the road to the development of this idea was not easy for the investor. The enthusiastic designer in his quest for rainbows must keep his feet on the solid ground of commercial success, and yet, looking back over the state of the art, these early efforts are of interest from the point of view of the difficulties which have been overcome and the suggestions many of them still contain, which may be embodied in future work.

The efforts of the writer were rather confined to the production of smaller units. It was thought that a motor for running sewing machines would be a money maker, and Fig. 4 shows a small motor which he designed for this purpose. It had a flame igniter, and was cooled by an air jacket in which a draft was induced by injector action of the air escaping from the crank chamber. It was a beautiful little piece of mechanism, and in the hands of a skilled mechanic, who would keep it clean and take care of it, it seemed that nothing could be more perfect; but alas the average woman could not qualify. The necessary care could not be depended upon, and after many months of hard work I gave up the idea and started in on easier problems.

The problem of igniting the charge was a very serious one in the early days as electric apparatus adequate to produce reliable ignition had not yet been developed. I made several attempts at jump spark apparatus, but it was always unreliable in some respects. I had a little sparking dynamo made by a friend in the electric business, which was all right; but the method of insulating the terminals had not yet been worked out satisfactorily. Mica was used, but was liable to become water-soaked. The general impression was that the flame was the most reliable thing. Many months of work were devoted to the production of flame igniters which were probably as reliable as could be expected of them. The difficulties, of course, always lay in the fact that the flame must be carried in through a valve and the soot and oil used in lubricating the valve soon destroyed the joint-forming surfaces.

The next expedient was the hot tube, which had many features of value but could not compare with the present method of igniting the charge by electric spark. I also used incandescent wire, heated by electric current.

Simple as the igniting apparatus of an engine is, there is nothing of more importance, and yet even today the problem is unsettled and many people are at work making improvements along this line. But undoubtedly the lack of absolutely perfect ignition has been one of the features which has retarded the development of the gas engine. I still look for improvement in this line, although there are many serviceable forms of igniting apparatus which operate reliably, under reasonable care. That the gas engine engineer is dependent upon the electrician for the solution of one of the most important problems in his art shows how the arts are allied.

When one looks back over the march of improvement in any art, what naturally strikes the observer is the amount of work which has been expended in developing side issues or modifications of what was finally proved the fittest device. Most of these ideas, like that of Prof. Atkinson, are based on theory which warrants the attempt to produce a structure to carry it out, but very often the complications more than neutralize the supposed advantages of the proposed structure.

It is well known that the losses in a gas engine occur largely at the beginning of its stroke, while the charge is

*Presented at the New York Meeting (December, 1908) of The American Society of Mechanical Engineers.

†National Meter Co., 42d St. and First Ave., New York City.

at its highest temperature and pressure. These losses are due not only to leakage, but to heat loss. It would seem, therefore, that the quicker the power could be utilized the greater the economy to be secured. With this idea in view I devised a link motion for the connecting mechanism, which could be arranged to give an extremely high speed at the beginning of the stroke and a slower speed at the end. Such a device is illustrated in Fig. 5.

A study of this motion will demonstrate the fact that by shortening the connecting rod A the speed ratio of

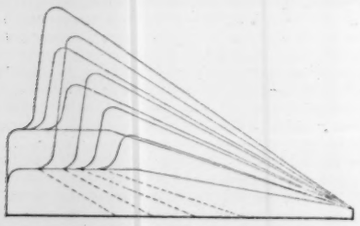


Fig. 2. Diagram Indicating Form of Cards of Marine Engine Admitting Charge Under Variable Cut-off and Pressure.

the piston at the beginning of the stroke can be increased two or three times. In order to avoid side thrust upon the members, the link B is used.

The difficulties of this design lay in the greater number of bearing parts to keep in order, and also in the fact that any gain in increased speed was at the expense of increased pressure upon the crank pin. It was necessary, therefore, to use larger connections and larger shafts for a given size cylinder, and the difference in economy did not appear great enough to pay for the additional parts and their maintenance; the idea has therefore been abandoned after test. It seemed that all that could be obtained in this way could be gained by a longer stroke engine or an increase in the number of revolutions. I have seen this idea exploited by other parties since, but it has never attained commercial value. I think it may be laid down as a rule in the designing of any kind of mechanism that the idea should be a simple one and that any departure toward complexity is a mistake.

As gas engines increased in size, it became more and more difficult to start them by the old method of turning over the fly wheel by hand. Various devices for this purpose were tried out and apparently are tried out again and again by new inventors. One method was to introduce a charge of combustible mixture into the cylinder by a hand pump, and after the piston was started to ignite the charge and then expect the engine to continue operations from the one impulse. Such a method can be made to succeed, but often a single impulse will not drive the engine with sufficient speed to take in the next charge, in which case the operation has to be tried over again.

Another means tried by the author and used by others is a cartridge containing an explosive, such as gunpowder, obtaining the first impulse by the explosion of this charge. Such a device has the same fault as that of the first, the use of a combustible mixture, and the additional fault that the products of combustion are usually dirty and tend to fill the cylinder with particles of matter that may give trouble in the regular operation of the machine.

Starting by compressed air, however, has seemed to fill the required conditions, offering the simplest method of obtaining the desired momentum of the engine. The only objection to this method of starting is in the cost of mechanism necessary to carry it out, which is quite an item when dealing with small units but of very little importance when dealing with large ones. This method was the one I had intended to use in marine engine work, and as soon as our engines were of sufficient size to require power starting, we made use of this method, having sought in vain for a less expensive one. It is probably the standard method today for all large units, and offers a means of handling the gas engine in either direction with the same degree of certainty in starting and reversing possessed by first-class steam engines.

In connection with mechanical curiosities, Fig. 6 shows a reciprocating piston device arranged to have also a rotary motion, which at one time was used in small motors with the idea that the piston could be made to operate as its own valve for admitting and ejecting the charge. The difficulty with this idea consisted as before in the complication of parts, universal joints introduced at the crank end and the wrist pin end of the connecting rod, and also in the fact that a plunger having this motion will wear out very much faster than a similar plunger running with reciprocating motion alone. As a matter of fact, this combined reciprocation and twisting is just the motion which a mechanic uses in lapping out a hole with a lap, and it demonstrated its utility in this respect in the first machines made. I used the motion in a plunger valve for small motors, but soon abandoned it for the reason stated. The device has since been utilized in an oil pump for lubricators, and there it may not have the faults which developed when the attempt was made to use it as a piston for a gas engine.

The idea of a piston which would form its own valve still persisted and a two-cycle machine intended to use this principle is illustrated in Fig. 7. So far as I know, this is the first of the so-called two-cycle valveless engines, the charge being admitted and deflected at the end of the piston stroke so as to drive out the products of combustion. Curiously enough, this broad idea has been developed into a multitude of forms, and there are now probably more people manufacturing small motors of this type than any other single type of gas engine structure. I freely confess that I did not appreciate the value of this idea at the time it was conceived, but confined my two-cycle work to the forms of structures in which mechanically operated valves were used. The evolution of the gas engine, however, has proved that the demand in small units was for simplicity rather than for economy, and I did not realize this until others had proved it to be a fact. This leads one to quote the celebrated saying of Mr. Beecher, "If his foresight had only been as good as his hindsight, he would have avoided many mistakes."

Another device tested out and actually put in service, and closely on the line of the Diesel work of today, is illustrated in Fig. 8. This application was an old one and experiments were made very much earlier than the date of the patent. Fuel was introduced in the form of a spray or jet and burned in a volume of air, the mixing being performed by the intensity of the flow of the gas itself. Cards taken from this engine can be made to assume either the form of the Otto cycle, wherein what is practically an explosion takes place, or the form of the card shown in the Diesel engine, in which

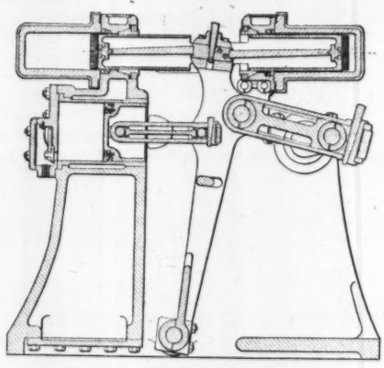


Fig. 3. High-Pressure Engine.

the burning of the charge is slower, the whole depending upon the velocity of the jet as it enters the combustion chamber. If the jet is forced in with a very high velocity a complete mixture of gas and air takes place before the flame is communicated to the charge and a practical explosion is the result. If on the other hand the charge is allowed to enter with less velocity it will burn as it enters and impart a gradual heat to the charge. I do not know why I did not go further with this idea as it had many features of advantage.

The difficulty of ignition was still present in those days, the hot tubes which I used for ignition giving trouble with high pressures. If the present electric igniter had been available the engine would have proved a commercial success. But I had spent much time on this engine and our company demanded an engine which could be sold and produce revenue; I therefore felt it necessary to come down to some simpler forms and make engines for the market, rather than to seek to develop broadly new ideas.

In the evolution of a device like the gas engine, the tendency is to assume certain fixed and definite forms, which are usually determined by the factors of simplicity and ease of maintenance. When all possible variations are designed and tried out, there comes a time when designers revert, by a sort of mutual consent, to a certain type. The vertical form of engine now seems to have taken the place of most others for moderate sizes. The two-cycle valveless engine still maintains its position for very small powers; while the two-cycle engine with controlled valves has been widely adopted for larger units. The double-acting form of device is naturally the one which requires the greatest amount of care in design and construction; but its advantages have led to its use in units of considerable power. Thus each particular type seems to find a little nook for which it is better adapted than the others, and a war of types still goes on, showing that the gas engine art is still in a mobile state.

The principal work of engine designers of later years has been the perfection of a simple form of structure which has proved itself as having in the long run the qualifications of durability and economy; so many builders are now making vertical engines in which the main features are similar that no one has a field to himself, the differences consisting rather in the arrangement of operating mechanism and methods of mixing and igniting of the gases of the cylinder. The structures we are now making have mechanically operated valves guided in long bearings so that wear is imperceptible. The causes of premature ignition are now better understood than formerly. They depend upon conditions which were overlooked in the design of construction; a small part which could get undercooled, or a portion of the combustion chamber not sufficiently provided with water jackets, was sufficient to cause premature ignition and prevent the highest economy which could be secured only by increased compression of the charge.

The pressures now carried are, on the average, double that which used to be the maximum in the Otto engine for city gas and four times as much as for producer gas. This has resulted in higher economy. The structures are also much more massive, or at least more metal is better distributed in relation to the work which it has to do. Methods of lubricating by the use of force feed apparatus make it possible to distribute the oil to those portions of the mechanism where it is absolutely needed, and improvements in the igniting apparatus have increased the reliability of operation of the machine.

The igniter has always been the weak point of the gas engine. My experience has shown that if the spark is intense enough the lighting of even a weak charge can be secured with a high degree of quickness. The method of advancing the spark to a new position seems to me unnecessary. There is always a minute interval of time after the spark has been made, while the surrounding mixture is being heated enough to transmit the flame. After the transmitting medium has once begun to flash, the time interval is extremely small. The lost time, therefore, is in that hesitancy of the mixture to light when a comparatively weak spark is used. It is, therefore, necessary to allow a certain interval when a weak spark is used, depending upon the weakness of the charge, because the particles nearest the igniter cannot instantly give out sufficient heat to transmit the flash into the charge. On the other hand, if the spark is so intense that it produces enough heat in itself to start the preliminary flame, the time of hesitancy can be made to disappear almost entirely, and the flash will be communicated with almost equal speed in any mixture available for power in a gas engine. The necessity for providing higher power in the igniter is being more and more clearly recognized by engine builders and we can now obtain mechanism for ignition of higher power than that formerly available.

This brief description of some of the ideas that I have seen tried out is offered in the hope that it may serve either to suggest ideas to those looking for improved devices, or perhaps to deter others from beginning experiments in lines which have already proved unsatisfactory. Ideas are constantly being repeated by men who have not come into contact with each other, each thinking himself the originator, and so the same experiments

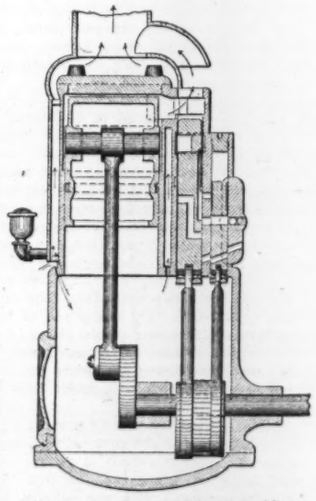


Fig. 4. Sewing-Machine Motor.

are often gone over and over by different people with much loss of time and money.

[The numbers and dates of the United States patents to which reference is made in this paper are as follows: 278,255, May 22, 1883; 334,035, Jan. 12, 1886; 312,408, Feb. 17, 1885; 289,019, Nov. 27, 1883; 378,847, Feb. 28, 1888; 386,211, July 17, 1888; 583,627, June 1, 1897.—Ed. "Journal" Am. Soc. M. E.]

THE NEED FOR CONSERVING THE MINERAL WEALTH OF THE UNITED STATES.*

The National Commission has submitted for your consideration today a preliminary compendium or inventory of the mineral resources of the United States. In this it has called attention to the large waste of materials and the large loss of life which characterizes these industries in all parts of the country.

The Commission has called your attention to the fact that one-half of the natural gas now coming out of the earth, about 1,000,000,000 cu. ft. per day, or more than enough to light all the cities of the United States having more than 100,000 population, is wasted by being allowed to escape into the atmosphere; and that this entire waste can be prevented by adequate state legislation similar to that now enforced in Indiana and one or two other states.

The Commission has also called your attention to the waste of material which is to a considerable extent preventable in the mining and extraction of various metal mining industries, as for lead, zinc, copper, gold and silver mining; and especially to the enormous waste in coal mining, which is equivalent to about one-half of the total product mined, or for the year 1907 about 240,000,000 tons. The aggregate of all these products of mineral waste for the past year is estimated to approximate $1,000,000 per day in value.

The mineral production of the United States during the past year was approximately $2,000,000,000, so that this estimated waste is equivalent to more than one-sixth the value of the total production.

The seriousness of this loss is more clearly appreciated when it is remembered that our production and consumption are increasing much more rapidly than is the population of the country; that the mineral supplies for future use are limited in quantity and are non-reproducible; that is, there are no new supplies being created to take the place of those which are being withdrawn from the earth and either used or wasted, and that hence when once these supplies are exhausted the exhaustion will be complete and permanent, and that at the increasing rate of consumption which has characterized the industry during the past few years the available supplies of certain of our more important resources, like the coal and the iron, will be early in the next century so nearly approaching exhaustion as to bring real hardship to the nation.

But more serious even than this question of the waste of materials is the excessive loss of life in our mining operations. We are grieved to find that during the past year in coal mines alone more than 3,000 men were killed and more than 7,000 injured; and our distress has increased rather than diminished, to find that the number of men killed in the United States for each 1,000 men employed in the mines is from 2 to 4 times as great as it is in other coal mining countries.

Of course it is not to be expected that the coal miners in the United States at 75 cts. per ton for their coal at the mine can take the elaborate precautions in behalf of the safety of the men and the protection of waste of fuel which are taken in European countries, where the value of the coal at the mine is more than twice this figure;

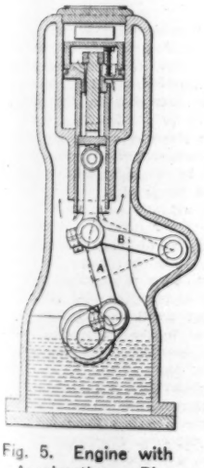


Fig. 5. Engine with Accelerating Piston.

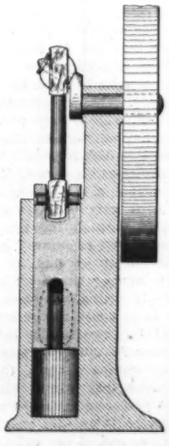


Fig. 6. Piston with Combined Reciprocating and Rotary Motion.

but the American people cannot afford to demand cheap coal at the cost of human life and the waste of the heritage which belongs to the next generation.

The miners and the operators are anxious to inaugurate these needed reforms, and certainly the American people are ready and willing to pay whatever increase in the cost of fuel may be found necessary in order to guarantee the safety of the miner and the saving of the fuel which belongs to the next generation.

It is not claimed for the statements presented to you in the Commission's report relative to the mineral wealth of the country that the data concerning the remaining available supplies of coal and iron and other mineral substances are strictly accurate, or that all this data is of the same degree of accuracy; but the Commission has presented to you a summary of all the data available on the subject and it has endeavored to make the best possible use of such data in reaching its conclusions.

Only data considered to be reliable has been used. It has refrained from making guesses and from using all data the accuracy of which was believed to be questionable.

But even should future developments prove that the estimates submitted at the present time are 10 or 20 or more per cent. in error, the strength of the argument for conservation stands out none the less prominently and positively.

The great fundamental facts brought to the front as a result of this work stands out clearly, viz.: that these mineral resources have required untold ages for their accumulation; that no human being has contributed toward this accumulation or has increased the intrinsic value of these resources, and hence their present owners, whether acquiring them through discovery or purchase, have no right to waste or destroy that which is necessary to the welfare of the nation, which they did not create, and which they cannot replace.

Therefore, whether at the present increasing rate of consumption certain of these resources will last 50 years or 100 years, is immaterial in our discussion of this question, in view of the fact that there are for those materials no known substitutes, and as compared to the life of the nation itself the duration of these supplies is short.

For certain of our more important resources, however, the data in hand is sufficiently complete to render pos-

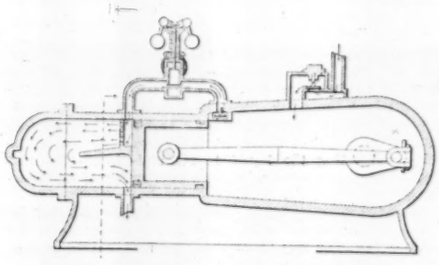


Fig. 7. Two-Cycle Valveless Engine.

sible fairly satisfactory estimates. That of coal supplies, which occupy an aggregate area of nearly 500,000 square miles, or about 15% of the total area of the United States, is estimated to contain about 1,400,000,000,000 tons of easily accessible coal available for mining under existing conditions. The boundaries of these coal fields are already so well known that the discovery of new deposits outside these boundaries is not likely to equal 1% of the total known supplies, and it is worthy of note that while the estimates submitted by the Commission as to the quantity of this coal available for mining under existing conditions were published and distributed to the geologists and mining engineers of the country more than six months ago, the only criticism of these estimates received up to the present time have been those asking for a reduction not an increase in the estimates of the supply.

The data concerning our iron ore supplies, while less complete than that concerning the coal, is nevertheless sufficiently definite to yield results of decided value. These estimates, based upon data gathered from every available source, indicate that we have in sight of high-grade iron ores, or such as are available for use under present economic conditions, 3,840,000,000 tons, of which nearly two-thirds is located in the Lake Superior district.

In addition to these, the final estimate of low-grade iron ores, which are not available for use under existing conditions, shows there are about 59 billion tons distributed through the iron producing districts. At the present increasing rate of consumption it is estimated that these high-grade iron ores will have been largely consumed by the middle of the present century; while the supplies of high-grade available coal may be extended to near the middle of the next century. Of course it is possible that either limited additional supplies of high-grade ores may be discovered, or that new methods may be developed which will render practicable the use of the better portions of these low-grade ores; but it is not likely that such additional discoveries will seriously extend the life of the high-grade ore supplies; and the use of the low-grade ores will involve also the use of low-grade fuels.

The chief waste in our oil supplies lies perhaps in their misuse; that is, their extensive use for fuel purposes—more than 18 million barrels having been used during the past year for locomotive fuel—for which purpose coal, as a more abundant fuel, might be appropri-

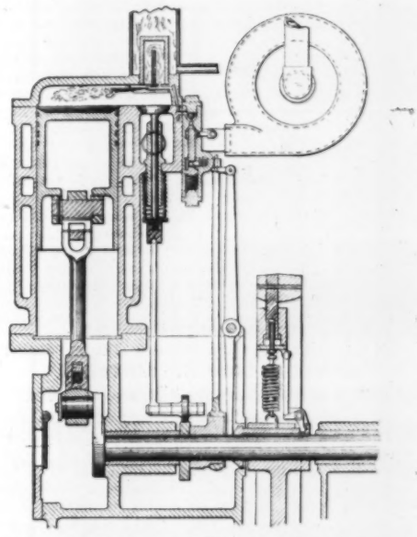


Fig. 8. High-Pressure Engine—Fuel Introduced in the Form of a Spray.

ately used, leaving the major uses of petroleum for lubricating, illuminating in isolated districts, and other purposes for which it has no known satisfactory substitutes.

No definite estimates are submitted relative to the available supplies for future use of copper, lead, zinc and the precious metals, for the reason that the limited and irregular areas occupied by these materials and the uncertainty as to their extent, makes it impossible to estimate accurately the quantity of materials available in any one lode or district until these have been thoroughly worked out. Judging, however, from the amounts of these materials in sight, it is estimated that without discovery of other deposits, at the present increasing rate of consumption the known supplies of those materials will not last beyond the present century, and the probability of the discovery of extensive new supplies is diminishing with each year.

But for these metals, as for the petroleum and natural gas, the indications are that other deposits will be discovered in the Middle and Western states which to a considerable degree will prolong the life of these supplies. The losses in the mining and treatment of these metals is even greater than in the case of the iron. In the case of the lead, zinc and iron ores, one of the chief sources of loss is in the destruction of the metals themselves through rust, electrolytic action, etc.

Among the mineral resources of lesser financial value, the conservation of the phosphate rock stands out with special importance because of the fact that this material is essential for the maintenance of the fertility of our soils. The known supplies of this material are quite limited, the quantity of high-grade phosphate rock now considered available for use aggregating less than 150,000,000 tons. The total amount consumed during the past 40 years has been about 30,000,000 tons; but the rate of consumption during this period has averaged nearly 120% increase for each decade. At this increasing rate, 25 years would suffice to exhaust the available known supplies. But so small is the phosphate supply in other countries, and so highly prized, that already 40% of our total production is being exported, and foreign capitalists are now endeavoring to secure for export purposes our largest known deposits of this material in the country.

The mineral production in the United States now exceeds two billion dollars per annum, and it contributes more than 65% of the total freight traffic of the country. We now produce nearly 500,000,000 tons of coal per annum, or 40% of the world's product. We also produce 38% of the world's iron; 22% of the world's gold; 60% of the world's copper.

In many of our mineral products we need not expect that imports from other countries will materially extend the life of our own supplies. Especially is this true of such vitally important articles as our mineral fuels and phosphate; but the possibility of obtaining limited supplies of other materials by import does not diminish the seriousness of the obligations which rest upon the people of this country to conserve the resources intended for use through the life of the nation, not simply the life of the individual.

In all our efforts to conserve our resources and to protect the lives and the health of the million men who

*Report submitted by the Minerals Section of the National Conservation Commission to the Conference on Dec. 9.

extract these metals from the earth, we will always be dependent upon the active cooperation of the states. The federal government should, and doubtless will, extend its investigations of these resources with a view to determining both their quality and their quantity, and to showing how these resources may be mined and used with increasingly greater efficiency. It will no doubt extend its investigations into the causes and methods of preventing mine accidents of all classes. But it must look to the states for the enactment and enforcement of laws looking to the protection of life and the prevention of waste—legislation based upon the facts developed through these investigations—legislation which will be fair to all interests concerned and which will help in the wise development and conservation of our resources.

John Dalzell, Pennsylvania, Chairman; Joseph M. Dixon, Montana; Frank P. Flint, California; Lee S. Overman, North Carolina; Philo Hall, South Dakota; James L. Slayden, Texas; Andrew Carnegie, New York; Charles R. Van Hise, Wisconsin; John Mitchell, Illinois; John Hays Hammond, Massachusetts; Irving Fisher, Yale University; I. C. White, West Virginia; J. A. Holmes, Geological Survey, Secretary.

AN UNHAMPERED CESSPOOL—A TRUE "SHORT STORY" OF DOMESTIC SANITATION.*

By ROBERT FLETCHER,† M. Am. Soc. C. E.

Not many years ago a maiden lady of limited means built a snug little home in the suburbs of a small city of one of the Middle States. The lot was on a rather steep slope, and the house was located about 50 ft. back from and 15 ft. higher than the highway, below which are other houses in tiers on a still sharper slope, descending about three hundred vertical feet to a large body of water. As the house was fitted with the usual fixtures of approved sanitary plumbing, a cesspool was provided to receive the sewage from the household, the personnel of which varied from two to six or seven. The resources of the surrounding community are not equal to providing an adequate system of sewerage, while the conditions described demand special care from the higher residents against making any nuisance for those lower down. Fortunately the soil is a slightly permeable clay hardpan, with rounded stones from nut size upwards.

According to the usual practice of this locality the cesspool is located in front of the house, just at the foot of the piazza terrace, so that the top is nearly on a level with the cellar floor within. In construction it is jug-shaped, as shown in the sketch (Fig. 1); paved and lined with stone, laid dry; the dome-like top terminating in a throat or manhole built up with brick and mortar; and tightly covered by a slab of Hudson River bluestone, even with the turf of the lawn. No rain water was admitted to this receptacle.

THE AILMENT AND FIRST AID.—A visiting relative declared that the conditions which he found, after this cistern had been in use about 21 months, constituted a flagrant sanitary misdemeanor. It was full; and exuding from beneath the cover was a black or dark green, slimy deposit, which spread a yard or two through the grass which only partly concealed it—always offensive to the sight and often to the smell. The owner met the remonstrances with the usual question and answer: "What can I do about it? We don't know any better way."

Obviously it was a case of choked cesspool needing relief; accordingly, the usual appliances and help were procured from the city, with the expectation that a large body of liquid must be *pumped* out and then a deposit of sludge *dug* out. But, as the pumping proceeded, the operators were surprised to find that the contents were all liquid—light, yellowish brown in color and not overpoweringly offensive to smell. There was not a shovelful of deposit or sludge left in the bottom, although a few blackish flakes of flocculent matter came out through the pump. The bottom and sides of the cistern were at once sprinkled with about half a bushel of powdered air-slaked lime, and a person descended into it immediately, with not so much sense of offense as is experienced around the Moon Island plant of the Boston main drainage works.

Here a process of nature had been proceeding (regardless of the claims of any patentee or of court decisions)—as it always has proceeded under like conditions, and always must so proceed. But the operation had been hindered, and it was evident that the cesspool needed an outlet. Hence, a hole was made through the stonework about 2 ft. below the cover, and a combination of old-fashioned "blind drain" and pipe drain provided, as shown in the accompanying sketch. It is almost needless to explain that this arrangement of material was for the purpose of extending the region of percolation and filtration. The trench was about 40 ft. long, and the diameter of pipe in the lower half was reduced to 3 ins. The terminal pit shown in the lower sketch of Fig. 1 was an adaptation to the situation and intended to facilitate the filtration of the liquid to the surface of the lower terrace.

*Condensed from the "New Hampshire Sanitary Bulletin" for October, 1908.

†Director, Thayer School of Civil Engineering, Dartmouth College; member N. H. State Board of Health.

During about 18 months of subsequent use there has been no offense from the cesspool, the very existence of which would not be suspected if not for the stone cover, and the only indications of the existence of the pipe outlet and porous drain are the thicker growth of grass at the lower edge of the lawn and a luxuriant growth on the terrace slope near the pit; also a perceptible but inconspicuous seepage into the roadside ditch, which is so far purified as not to betray its origin to the sense of smell—even to a person working close to the ground with a grass sickle.

The owner in this instance knew nothing about "septic action" and her friend did not venture any explanation. There was no intention of providing a "home or workshop for colonies of bacteria," either anaerobic or aerobic; only a sense of the disagreeable necessity of tolerating a plain, unsavory cesspool, with an adjunct of a blind drain with some pipe in it. Whatever view might be taken of the case, theoretically, here was "circumstantial" evidence of some transforming process of Nature. The decision of the court had not then been given to the effect that the "process claims" of a well-known "septic tank" patent are valid. Considering that Nature has always operated in cesspools regardless of human agency, it was not supposed that ownership

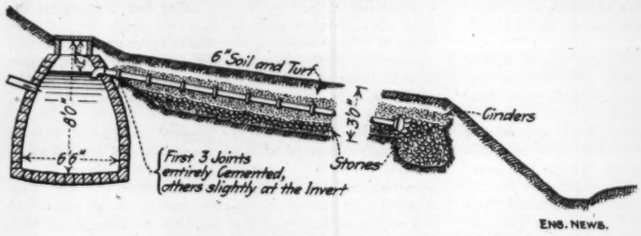


FIG. 1. A HOUSEHOLD CESSPOOL AND OVERFLOW.

could be vested in any such operations in analogous receptacles.

In this case evidently, *as in other proper cesspools*, there was "the process of" (partially) "purifying sewage which consists in subjecting the sewage under exclusion of air, of light and of agitation to the action of" (as alleged by scientific investigators, some agency which they term) "anaerobic bacteria, until the whole mass of solid organic matter contained therein becomes liquefied"; but the next clause of the specification—"and then **subjecting the liquid to air and light**"—does not apply here, since there was no subsequent open exposure.

SUGGESTIONS FROM EXPERIENCE.—This bit of practical experience which came to the knowledge of the writer (at first hand) does not present anything new, but simply shows an *adaptation and combination* of materials and construction long known and used. Something similar to this particular combination has been before suggested, but for a level situation.

The arrangement described is doubtless crude in some particulars, being conformed to a financial status of

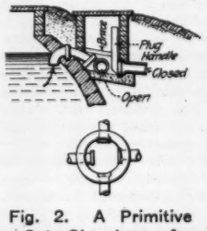


Fig. 2. A Primitive Gate-Chamber for Distributing Cesspool or Septic Tank Discharge to Various Outlets.

Fig. 3. A Convenient Method of Closing a Cesspool Overflow Pipe from the Surface.

"limited means" and to the special conditions of sloping ground and a soil not very permeable. In gravelly or otherwise porous ground the tank must be water-tight, so as to retain the contents and avoid pollution of the surrounding soil; also the stones in the trench may be omitted if coarse and fine cinders are available; or, if cinders are not to be had, the gravel should be screened and the coarser grade put around the pipe and the finer grades on the sides of the trench and over the coarser stuff so as to prevent ingress of the adjacent soil to clog the drain.

The reader will notice also that an adequate *outer termination* is quite important; and hence a suitable even grade must be given to the trench on the bottom, and the pipe laid truly in its own place on a corresponding grade; then the outlet must be low enough to permit free and steady flow and percolation outwards.

GUIDING PRINCIPLES.—We note four fundamental principles for a *small* disposal plant:

(1.) *In the tank or cesspool proper there must be gradual motion* (not necessarily regular or continuous) *from inflow to outflow a state borderi* quiescence. *It is essentially a slow process*, spoiled hastening it. Necessarily both the inlet and outlet must dip 6 ins. or more below the surface of the istern; the inlet, to mitigate the disturbance of inflo the outlet so as to exclude from the drain any scu undigested floating matter.

(2.) *Excess of water or dilution in th stage must be avoided. The sewage itself conta* ite water *enough. The deoxidizing process must* hindered.

(3.) *The effluent from the tank must* ree or un- *hindered outflow, which must not be* pid. The blind drain, combined with a suitably subsoil, provides the necessary slow percolation aeration. If possible, it should be long enough to a the entire process to be accomplished underground. at nothing more than inoffensive seepage shall come surface.

(4.) *Any considerable deposit of sludg the cesspool indicates incomplete or imperfect a* probably due to violation of principles 1 or 2, or both. Briefly, it is not likely that one will make a ces too large or too deep. Many are made too small and shallow, of which that abomination of house-drainage a "grease-trap," is an extreme example. All necessary conditions are best realized in a *large, tight tank* or cistern, when there is the least dilution of the sewage. In the successful operation described, the supply of water was from a spring, and while sufficient for all reasonable demands, is not unduly wasted, so that the sewage is "strong" as compared with that where no care is had to avoid waste of water.

While these principles have general application, it is important to note that we are now considering them only in relation to sanitary disposal for a single dwelling, or two or three at most. When the larger problem of disposal for a small group of houses, a large hotel, or a village, is to be solved, advice should be sought from a competent sanitary engineer.

Even in the simpler cases, the treatment must be varied to suit the conditions. Evidently a soil saturated by ground-water is an impossible situation. Nearly level ground, especially if not very permeable, like clay, may require considerable extension of the trench, perhaps terminated by a larger pit filled with medium-sized stone, or coarse cinders (clinker) or coke, with care taken to keep out surface water. This, *if its porosity is maintained*, increases the percolating area. Many heavy soils, short of pure clay, allow more percolation than would at first appear possible. Again, the householder may be hampered by a narrow lot and small area under his control, so that sufficient extension of a single trench is not permissible. In such a case two or more trenches may be made, radiating from the cesspool, and the drainage diverted through them in succession. This requires a device for shifting or switching the discharge.

A small chamber, made of concrete or brick laid in cement mortar, may be built just outside the throat of the cesspool (or "septic tank," if such be in use), and the effluent coming over may pass from the bottom of this into one of two or three pipe drains, the others being stopped by a wooden plug (or standard gate-valves may be used by those preferring to incur the expense). The construction is indicated in the detail sketch, Fig. 2. The plugs each have a 2 × 2-in. wooden handle and may be stayed in place by a properly fitted board or disk formed into the segment of a circle. When a drain needs a rest, it may be closed by a plug taken from one of the others opened for service.

Or it may be more convenient and less expensive to insert through the masonry of the cistern, around the throat, two or more T branches of ordinary glazed pipe, the branch serving for outlet into the drain. To close the unused drain or drains have a wooden stopper loosely fitting the main stem of the pipe, and let down so as to cover the outlet. (For detail see Fig. 3.)

If the question is raised as to the freezing of such drains in northern localities, we may admit that frost may encroach upon them in the periods of inaction through long winter nights, especially if the ground is not protected by snow or leaves during weeks of severe cold. A thick turf over the trenches is a favorable condition, and if the drains do not clog, experience proves that it is a rare case where a drain 2 or 3 ft. deep, carrying domestic sewage—which has a normal temperature of 50° F. or more—actually freezes to the point of stoppage, *unless the outlet is allowed to freeze*. It is easy to put a slight covering of leaves and brush at points of exposure.

In conclusion, let not the reader suppose that this is an argument or even an apology for use of cesspools. They are only justified as a last resort. The single purpose is to show how the offense of one cesspool was greatly subdued (other instances are on record), and the abominable thing made semi-respectable; also to make a few suggestions of simple and inexpensive methods and construction.

A NEW TYPE OF JIG FOR THE SEPARATION OF METALLIC ORES.*

By ARTHUR TAYLOR, M. I. M. M.†

When ores are carefully classified, the lowest size that can be jigged satisfactorily is above a 16-mesh sieve, and the writer thinks he is right in saying that jigging is not often applied even to such a fine size. When less careful classification is resorted to, and fine stuff is allowed to pass over a jig with the coarser, much ore is lost.

In the ordinary mechanical jig a speed of 300 r.p.m. is about the maximum, with a minimum stroke of, say, 2 mm. to 4 mm.; and even with this, there is much strain on the parts and corresponding wear and tear. The irregular beat of the plunger causes too great a rush of water, and that carries upwards the minute particles of ore.

In the opinion of the writer, the finest slimes that can be treated by any mechanical means can be treated with excellent results in jigs, more conveniently, and with less working expenses and less cost in plant than by any other apparatus, provided the jigs are of a suitable construction.

In the first place the pulsating action must be reduced to a minimum, and the rapidity of the stroke increased up to the point of a simple vibration, and the supply of water should be regulated to be just sufficient to keep the matter in a state of semi-suspension, like a quicksand; enough to prevent packing and to allow of the shifting of the particles one on the other, but not enough to lift them and allow the finer particles to be carried up by the current.

A constant movement is indispensable to prevent the establishment of uneven currents, to produce an even distribution of the minerals and the water, as well as to provide the interchange of position of the particles one on the other, quite distinct from the regular rise and fall of the particles produced by the even beat of a plunger. Also a most important point is that in the case of fine slimes the vibration certainly promotes the more rapid settling from the water of the suspended matter. This diminishes the loss in the case of impalpable slimes flowing over jigs.

The writer has met the requirements of the case by a complete modification in the form of apparatus and the substitution of a vibrator for the plunger, thus suppressing the portion of the hutch in which the plunger works. The vibrator is fixed to the hutch which carries the screen; or it can be attached to the screen by arranging this so as to have free motion in the hutch.

The action of the vibrator depends on the fact that a rapidly revolving mass tends to rotate round its center of gravity, and if the center of rotation is uncontrolled it will coincide with the center of gravity.

The vibrator designed by the writer is as follows: A shaft provided with weights in the forms of disks or flywheels attached, and constructed in such a manner that the journals of the shaft do not coincide with the center of gravity of the mass. On a rapid rotation being imparted to the whole, the tendency of the mass to rotate on its center of gravity transmits the vibration through the journals and their bearings to the supports, or connecting rods, which communicate it to the required point.

The details of construction will be seen on the accompanying illustration, Fig. 1, which shows the vibrator more or less in diagrammatic form.

The steel vibrator shaft A has eccentric journals B at each end (the center of the journal being 2 mm. from the center of the shaft). On the shaft are firmly keyed two collars or sleeves C provided with shoulders, and on these sleeves are fixed the eccentric disks or fly-wheels D, the centers of which are 2 mm. from the true centers of the disks. The position of the disk in relation to the center of the journals is regulated by turning the disk on the collar, to which it can be firmly fixed by means of bolts E. The collar is pierced by several holes, pairs of which correspond with the two on the disk in such a way that any desired amount of eccentricity can be given.

The holes are numbered so as to insure correct setting. At zero the disks are practically concentric with the journals of the shaft, at No. 4 they have the maximum eccentricity of 4 mm. In the center of the shaft is fixed the driving pulley F, the boss of which is also eccentric and provided with several keyways in order that it can be set in such a position that it will rotate as nearly as possible concentrically.

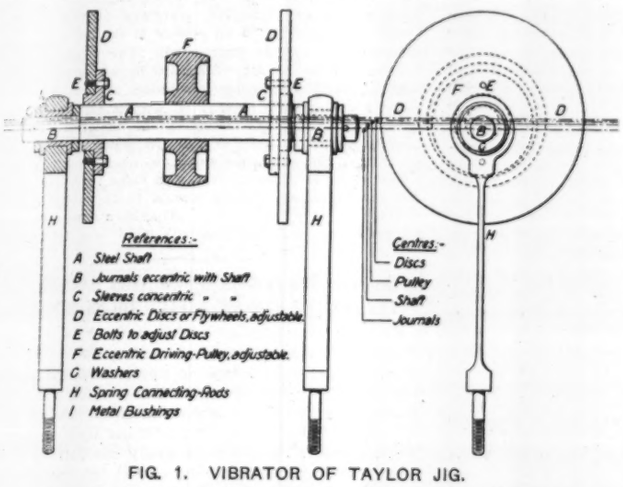


FIG. 1. VIBRATOR OF TAYLOR JIG.

The vibrator is supported on two spring connecting rods H. They are forged out of one piece of spring steel and provided with metal bushings I. The two bushings are practically the only parts in the whole apparatus subject to any wear, and they will last several months if made of ordinary white metal.

The connecting rods are firmly bolted to crossbars or bridge pieces K fixed to the sides of the hutch L. The method of attachment and the relative position of the vibrator and hutch are shown in Figs. 2, 3 and 4.

The hutch L is a hopper-shaped box from 60 to 75 cm. long and 35 to 40 cm. wide. The upper part is parallel and built of 3 or 4-mm. steel plate. The lower part, hopper-shaped, is of the same material but thinner. The two large sides of the hopper are rendered flexible by the insertion of sheets of india rubber or strong canvas M, to allow of the freer vibration or pulsation of the hutch by liberating it from the inertia of the mass of water. A trial was made of a hopper constructed of very thin steel or phosphor-bronze plates, but, although they worked satisfactorily, the metal could not stand the strain, and at the end of a few weeks the plates would crack or break away from the rivets. At the bottom of the hopper is a valve N for drawing off the concentrates.

On the sides of the hutch are four rectangular lugs or supports O, on which the whole apparatus is hung, on two parallel beams, P. Four bolts or spindles are fixed in the beams, passing through holes in the lugs to keep the whole in place, the lugs being supported by stiff spiral steel or india rubber springs, both above and below. In Fig. 2 are shown the alternative fittings with spiral and india rubber springs. On the spindles are nuts to tighten or loosen the springs as may be required for the proper working.

Inside the hutch at the top of the hopper is a ledge on which is supported a cast steel grating R, which carries the wire gauze, with another similar grating above to keep it in place, all being firmly fixed with hardwood wedges and iron lugs on the inside of the hutch. The space between the edges of the grating and the hutch walls is packed with slips of soft wood of cord to prevent leakage.

At one end of the hopper and under the grating is fixed a short pipe S, connected by a flexible tube to a tap, for the introduction of water.

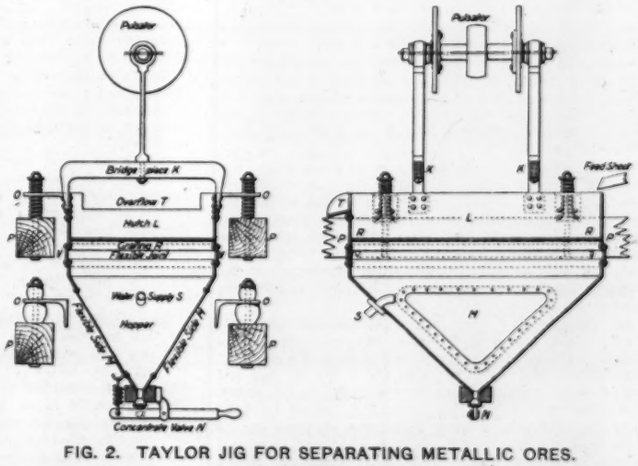


FIG. 2. TAYLOR JIG FOR SEPARATING METALLIC ORES.

An overflow lip T is placed at one end of the hutch, arranged so that it can be raised or lowered to regulate the thickness of the bed above the grating. In some cases, such as when there are more than two jigs in a set, or in dealing with very firm slimes, it has been found advantageous to draw off part of the water coming off the jig apart from the material under treatment. If this was not done, the increased flow of water over the lower jigs in the set would carry the ore away. The lip can therefore be made in two stages. Above the lower one are placed a series of holes through which the material escapes with a certain quantity of water and flows into the next jig, while the superabundant water flows over the top lip and is conducted away to waste. This arrangement also has the advantage of checking the flow and leaving a certain depth of water on the bed.

The wire gauze of the screen should be far coarser than the material under treatment, say, ten mesh for stuff passed through a 14-mesh sieve, and never less than 50, even for stuff that will pass through a 250 mesh, that is to say, the finest slimes. On the gauze screen is placed a thin bed, from 25 to 50 mm. deep, of lead shot, "small dust" for the finest ores, up to Nos. 6 or 8 for the coarser sizes. On the shot is placed the true bed on which the separation takes place. The chief use of the shot is to keep the bed off the screen, as it would otherwise get choked, and it allows of a much coarser gauze being used.

The construction of these jigs is entirely the same for coarse or fine ore, and all parts should be interchangeable, the only exception being that the disks are made heavier for the coarser ores, the weights varying from 2½ kg. to 5 kg., the lighter ones being driven at about 1,500 r. p. m., with perhaps 1 mm. eccentricity, the heavier ones at 500 r. p. m. with the maximum of 4 mm. eccentricity. Of course the length of stroke is far less than the amount of the eccentricity. The speed is governed by the size of the pulleys driving each jig and is not adjustable.

The most important and entirely new features in the construction consist in obtaining the required movement by a rapidly rotating eccentrically balanced weight, so constructed that it can be adjusted with ease and rapidity. The revolving weight is only supported on two journals. There are no cranks, eccentric straps, or other moving parts held rigidly to a bed or other fixtures by bearings and supports. The spring connecting rods allow of free uncontrolled lateral vibration, and only transmit the required vertical vibration. There are thus only two bearings subject to wear. The whole of the power is usefully applied, none is lost in rigidly-held parts transmitting thrust and vibration to bedplates, supporting frames or other surroundings.

The whole apparatus is hung on springs and has to vibrate. It may be objected that it will require considerable power to set in motion the whole weight of the hutch, the water and the heavy charge it contains. This is not the case. The hutch, which is not heavy, vibrates independently. That is to say, that at the down stroke it is relieved of the weight of water and ore, etc. The flexible sides of the hopper bulge inwards as it comes down, the grating being forced down into the water, and the bed remains suspended. On the up-stroke the water returns through the grating and the flexible sides bulge outwards and the bed comes down into the grating. There can be no doubt that should the vibrator be fixed to a solid "dead" mass of the same weight, the power required would be incomparably greater.

Other modifications of the principle have been constructed and proposed, as, for instance, a flexible joint, V, connecting the upper and lower parts of the hutch, as shown in Fig. 2, instead of the flexible sides. This works well and is especially useful for coarser material where the stroke should be larger and slower. Another modification is to have the vibrator attached simply to a frame in which is fixed the screen. The frame is hung on springs and is partially submerged in the hutch of water, as in the old hand jigs, the waste being carried off over a flexible overflow attached both to the hutch and the frame (Fig. 3). This gave excellent results but is not such a neat and compact apparatus.

Another proposed modification is the application of the vibrator to a plunger in a jig of similar construction to

*A paper presented at a meeting of the Institution of Mining and Metallurgy, Oct. 15, 1908.

†Sociedad Minera Dos Naciones, Posadas, Provincia de Cordoba, Spain.

those in general use. This modification is shown in Fig. 4 and would be designed to work with a much heavier vibrator at a lower rate of speed.

Before going into further details as to the working of these jigs it will be well to describe the nature of the stuff they have been treating and the general conditions under which the concentration of ore is carried on at the Calamon Mine, near Cordoba, Spain, where the trials were made.

The ore as it comes from the mine is composed of galena and blende in the proportion of about one of the former to four of the latter, mixed with carbonate of lime, slate and clay, as well as small quantities of carbonate of lead, iron pyrites, quartz, etc. The carbonate of lead is troublesome, as much of it goes with the

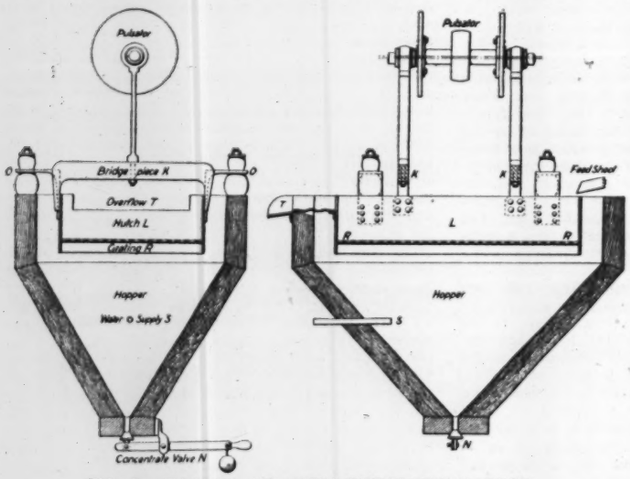


FIG. 3. TAYLOR JIG WITH DETACHED HOPPER.

blende, also sometimes the slate is impregnated with the carbonates and tends to give an undue lead assay in the waste. The small quantity of iron pyrites goes mostly with the galena, but it is a negligible quantity.

The quartz is generally hard and flinty, impregnated with blende, and often closely resembles good blende though only containing 5 to 20% zinc. This tends to lower the value of the blende and raise the zinc contents of the waste. The lodes being very soft there is an exceptionally large proportion of fine ore and slimes. As the galena and blende are somewhat intimately mixed, fine crushing is necessary. The galena is concentrated up to an average of 70% of lead and 7% of silver; the blende to 40% zinc and 1.5% of silver. It will be understood that with such valuable products most careful manipulation and every effort to prevent loss are necessary.

The writer was entrusted with the designing and erection of a concentrating plant to deal with these ores. The plant consisted of the usual grizzly, stone-breaker, crusher rolls, classifying trommels, machine jigs, spitzkasten and round buddles. The ore passes automatically by gravity through the whole series. A secondary complete plant deals with the secondary products. To obtain as clean a separation of the galena and blende as possible, a very careful classification was adopted and the stuff divided into eight sizes for jigging in eight four-compartment jigs of the ordinary plunger type, the first jigs treating stuff under 12 mm. and the last taking stuff passed through a 14-mesh gauze and through a spitzkasten. Thus the last jig of the old type treats stuff below 1 mm., a large proportion, the galena especially, being very fine for that class of jig. Originally the stuff from over this first spitzkasten passed into another feeding the first buddle and flowing on over three ordinary conical slime separators, of increasing dimensions, each feeding a round buddle, and finally to clarifying pits.

All the jigs give clean galena in the first compartment, mixed galena and blende in the second, clean blende in the third and mixed ore and waste ore chatts in the fourth. The waste contains about ½% of lead and 2% of zinc. The clean ore goes straight to the stores. The mixed galena and blende are first treated by hand in a jig, and give a good proportion of clean ore of each class, the true mixed ore is crushed and re-treated in the secondary plant. The chatts from the fourth compartment are all put through the secondary plant. The stuff from the buddles had all to be re-treated, even the "tails" required to be passed a second time. The "middles" and "heads" had to be treated over many times and finally washed by hand in strips or sluices to get even a fair separation of the galena and blende.

The average amount of stuff passed through the floors per day of nine hours is 80 to 90 tons. The amount of water required is 4 or 5 cu. m. per min., the greater part of which water is returned by centrifugal pumps after clarifying. The whole of the plant is driven by a 100-HP. high and low-pressure condensing engine.

The want of a better system of treating the slimes provided an excellent opportunity to the writer to apply the use of his new jig. Experiments were first made with a single jig. The results were so satisfactory that it was at once decided to put up a complete installation of four sets of four jigs; each set corresponding to one large jig of four compartments of the ordinary type. They were placed to take the stuff passing over the spitzkasten supplying the last large jig, *i. e.*, the stuff which was before sent on to the buddles, being all the sand and slimes below 14 mesh, deprived of the greater part of their coarser ore and the coarsest sand.

By the time the stuff arrives at this point there is a large quantity of water to deal with, as at each successive operation some water is added from the grizzly down to the spitzkasten of the last large jig. The spitzkasten have, therefore, to be of large dimensions.

A separate spitzkasten supplies each set of four little jigs with a different size stuff; the first coarse silt, the second fine silt, the third finest silt, and the fourth almost mud.

Naturally, on account of the action of the spitzkasten, the galena contained in the different sizes of stuff is far finer than the waste. Even in the first jig nearly the whole of the galena will pass through a 40-mesh sieve and a large proportion through a 100-mesh. That from the last jig will nearly all pass through a 100-mesh sieve, and 50% of it through a 250-mesh.

The galena obtained runs from 75% to 65% of lead with 5 to 10% of zinc, and the blende from 45 to 30% zinc and from 5 to 10% lead. The proportion of lead and zinc in the mixed ores from the second jigs varies much. The ores are separated as far as possible by hand washing. The product from the fourth jigs is turned back to pass through the same jigs again or to the secondary plant.

The waste contains about 2½% of lead and 3 or 4% of zinc. Nearly the whole of the lead contained is in an impalpable powder, for if sifted on a 250-mesh sieve, that which passes through will assay as much as 12% and what remains in the sieve only ½%.

The amount of stuff treated in these four sets of small jigs is from 750 to 1,000 kg. per hour. They complete a consecutive series treating twelve different sizes in which the first eight are four-compartment jigs of the ordinary type and four sets of the little jigs (each set of four corresponding to one four-compartment jig), beginning with 12 mm. down to below 250 mesh. The whole of the 80 or 90 tons per day is treated in the series. The average assay of the waste is less than 1% of lead, most of which is practically irrecoverable.

It may be added that the mud that will not settle in a conical slime separator 2 m. square is collected in large clarifiers and settling pits, and assays 8% of lead, 5% of zinc and 0.15% of silver. This is dried, burnt and sold to the smelters.

The cost of running the little jigs is small, two men and two boys being sufficient to run the series of 16. The power required is estimated roughly to be about ⅛-HP. per jig, or say, 5 HP. for 16. About ½-cu. m. of water is required per minute over and above that coming down with the stuff. The cost of lubrication and repairs is also light, as there are few parts to wear, and those cheaply renewed.

Recently another complete series of 16 jigs has been erected in such a manner that they can either form part of the secondary set of jigs for treating the by-products, or else be used apart for re-treating fine products from other sources, or for experimental purposes. The arrangement is the same as in the first set. They dress stuff below 14 mesh at the rate of one ton dry per hour. With coarse stuff the quantity would be greater. For some time they were profitably employed re-treating old dumps from the tails of buddles. In this case 50% of the galena recovered will pass through a 100-mesh. The waste carries 2½% lead, but 50% of that will pass through a 250-mesh, and 75% through a 100-mesh.

There is no doubt that these jigs will work profitably with sizes up to 8 or 10-mesh or even higher, especially as in these grades classification can be made according to size by sifting.

The jigs occupy but little space, in fact, little more than the useful surface of the grating. Complete they weigh from 40 to 50 kg. each, and are thus easy to transport, and pay but little import duty in foreign customs. They can be managed by any intelligent operator, although, like all other concentrating plant, they require care and attention, especially at first. They should be applicable to all classes of ore in which the differences of specific gravity will allow separation by weight. Sizing is not all-important, although advantageous, especially in the separation of ores of little difference in specific gravity. If a classification by size could be satisfactorily made in the material for the finer sizes, in the place of the spitzkasten, there is no doubt that the separation would be nearly perfect.

The writer is confident that with some little modification the apparatus described should be applicable to the washing of very small coal. Experiments will shortly be carried out with that end in view.

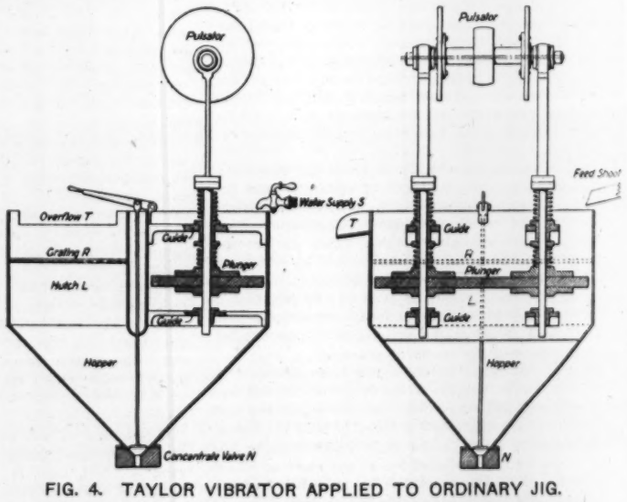


FIG. 4. TAYLOR VIBRATOR APPLIED TO ORDINARY JIG.

HEARING ON THE PROPOSED NEW YORK HARBOR OUTLET FOR THE PASSAIC VALLEY TRUNK SEWER.

For two days during the past week, the New York Harbor Line Board sat and patiently heard arguments, pro and con, on application made by the Passaic Valley Sewerage Commission for permission to build and maintain outlet works for the discharge of sewage at Robbins Reef in New York Harbor. While presumably the jurisdiction of the Government, as represented by the Board named, appertains only to matters affecting navigation in the harbor, yet the Board courteously heard arguments on almost every imaginable phase of the subject except those relating to the relative police jurisdictions of New York and New Jersey over the harbor of New York. The question of police jurisdiction, it may be stated, has been brought before the United States courts.

The Passaic Valley Sewerage Commission was represented at the hearing by several of its members, and also by Messrs. Edlow W. Harrison and Rudolph Hering, M.'s Am. Soc. C. E., Engineers to the Commission. The State and the City of New York were represented by Dr. Eugene H. Porter and Dr. Thomas Darlington, State and City Commissioners of Health, respectively, and also by Messrs. George A. Soper, M. Am. Soc. C. E., Daniel D. Jackson, and Prof. O. H. Landreth, M. Am. Soc. C. E. A large number of commercial and civic organizations of New York City were also represented at the hearing.

The general scheme of sewage disposal proposed for the relief of the Passaic River and in behalf of Newark and Paterson, and other New Jersey communities, includes, first, a trunk sewer from Paterson to Newark Bay, with various subsidiary pumping stations. At the bay, screen-

ing and sedimentation would be employed before the sewage passed through the main pumping station to be forced beneath Newark Bay, the Bayonne peninsula, and under New York Bay to the point of discharge. At Robbins Reef, not so very far from the Statue of Liberty, it is proposed to have multiple outlets discharging horizontally, the whole so designed and proportioned as to effect as great a degree of dispersion and diffusion of the sewage as may be deemed necessary for proper dilution. The outlets would be in a depth of at least 40 ft. of water. In its application to the War Department, the Commission stated in effect its willingness to accept whatever conditions, as to the removal of solid matter and otherwise, might be imposed by the Department.

Neither the plans and specifications filed with the application, nor the statements made by the Commission or its engineers at the hearing, gave anything very specific as to the details of the screens or settling basins, or as to the actual percentages of solid matter to be removed by these means. Stress was laid by the Commission and its representatives upon the declaration of the Commission already mentioned: that it stood ready to fulfill any requirements in these respects which the Government might lay down. The Commission and its representatives did make it apparent that reliance was placed upon the high dilution that would be afforded by the huge tidal volume into which the water would be discharged. It was claimed that sufficient screening would be done to remove all matter which might otherwise float on the surface of the water and create a nuisance, and that not enough solid matter would remain to cause serious shoaling of the harbor, after taking into account the distribution of the solid matter over a large area and the oxidation of the organic matter which it is expected will take place.

As might be expected under the circumstances, practically the only supporters of the application were the Passaic Valley Sewerage Commission and its representatives, and a few representatives of the municipalities included in the district. It was also to be expected that all those who appeared in behalf of New York City and State, and the various local organizations in New York City, would be strongly in opposition to the application. The State and City Commissioners of Health, and the layman representatives of the commercial and civic organizations, generally based their opposition on the broad general grounds either that no untreated sewage should be discharged into the waters surrounding New York City, or else that the pollution was already so great that no addition should be made to it. Obstruction to navigation, and nuisances and damages experienced by shipping due to floating matter and also to the action of gases upon the paint of shipping, were urged against the application. Various specific instances of the ill effects of the present pollution of the waters surrounding New York were cited by a number of speakers, but these all related to points or areas where the pollution is now very great and has been caused by the utter lack of attention to the most elementary principles of sewage discharge.

A number of the speakers in opposition laid considerable stress on dangers to health through present and future discharge of sewage into the harbor; but there was very little explanation indeed of how the public health was endangered in this particular. Such explanations as were made related chiefly to dangers through bathing in the vicinity of outlet sewers now discharging at the water front, and to the contamination of oysters in the bay.

Many of the layman speakers in opposition referred very confidently to various sewage-treatment works at home and abroad—chiefly abroad. These speakers seemed to think that New York and vicinity could readily dispose of the sewage from 5,000,000 people by septic tanks, percolating filters or sewage farms, and that by similar means the Passaic Sewerage District could put to good use the Newark or Hackensack meadows. Just how saturated, water-logged marsh lands, subject to flooding, could be connected into well-drained sandy areas, like the Berlin sewage farms, so frequently cited by the speakers, was not made apparent.

The experts in behalf of New York State and City urged that the permit applied for ought to be refused because of the already polluted condition of the harbor, the apparent inadequacy of the screening and sedimentation facilities proposed on the one hand, and on the other the uncertainties attending the whole matter of disposal by dilution in New York Bay. The uncertainties claimed included both the volume and the movement of tidal waters available for dilution, and also the effect of salt water upon the deposition of the solid matters in the sewage.

The experts dwelt at some length upon the Moon Island outlet of the Boston sewerage system, citing both personal observations and printed matter designed to show that the sewage from this outlet creates a nuisance over a large area. The supporters of the Passaic scheme urged in reply that the Moon Island outlet was the oldest of those discharging sewage into Boston Harbor, and that the later outlets built by the Metropolitan Sewerage District for Boston and vicinity had each in chronological succession been an improvement over its immediate predecessor. [See reference to latest report of the Massachusetts State Board of Health, in the course of our editorial discussion, elsewhere in this issue.]

Many of the speakers in opposition to the permit urged that the permit should be denied, at least for the present, in view of what New York City and State are doing and proposing to do to prevent pollution on the part of New York City. No very specific activities in these lines were described, aside from such relatively minor efforts as those directed against the pollution of the Gowanus Canal and the investigations made by the New York Bay Pollution Commission and its successor, the Metropolitan Sewerage Commission.

At the conclusion of the hearing, invitations were extended to any who might wish to do so, to send written opinions on the matter in hand to the New York Harbor Line Board, 39 Whitehall St., New York City, up to and including Monday, Dec. 21.

THE TYPHOID FEVER OUTBREAK at Reading, Pa., numbered 616 cases and 20 deaths reported up to 9 p. m., Dec. 14. Cases in the last few days seem to have fallen off materially.

THE GOLD ST. SEWER CAVE-IN in Brooklyn, N. Y., noted in our issue of Nov. 26, 1908, has been reported by the coroner's jury as an accident for which the cause is not apparent.

A COAL MINE EXPLOSION in the W. T. Rend mine near Benton, Ill., Dec. 12, killed three men. The accident is ascribed to the ignition of gas by a "windy" shot. All of the miners except the three shot firers had withdrawn from the mine to await the firing of the blast.

A WATER TANK FELL THROUGH THE ROOF of a wood working establishment on the corner of Leadenhall and Montgomery Sts., in Baltimore, Md., Dec. 14, tearing out the front wall of the building and practically destroying every one of the four floors. One man was killed and two severely injured. The tank was said to contain 5,000 gals. of water. Several carpenters and painters were at work on the roof of the building at the time of the accident, and it is thought that repairs were being made on the tank or its supports.

A DYNAMITE EXPLOSION ON THE PANAMA CANAL at Bas Obispo, Dec. 12, resulted in the death of 14 men and the injury of about 50 others. A 90-ton steam shovel was entirely wrecked by flying rocks and the men composing its crew were among those killed. The accident was the result of the premature explosion of a mammoth blast of more than 20 tons of dynamite. It is reported that the blast consisted of 51 holes each 60 ft. deep. During the charging of the last of these holes the charge exploded and the charges in the other holes were set off by the concussion, no electrical connection having been made between the separate holes. It is stated that the charging operation was being performed by a competent and experienced man and no satisfactory explanation of the accident has yet been advanced.

FOREST FIRES IN PENNSYLVANIA, it is reported, burned over an area of 850,000 acres during the past year, and cost the state and counties some $125,000 for fighting the fires. In addition, it is estimated that the damage per acre due to the fires was $1.50, which would bring the total estimated loss up to $1,275,000. The area of the state lands burned over is given as only 3½% of the whole area damaged by fire, and is only 3¾% of the entire holdings of the state. It is said that the relative freedom of the state lands from fire is due to the watchfulness of the State Forestry Department.

EXPLOSIONS OF DYNAMITE, nitroglycerin and powder occurring Dec. 7 and 8 caused the death of 13 men and the injury of 30 others. The premature explosion of a charge of dynamite at the Grand Trunk Pacific Ry.'s construction work near Bakerbrook, N. B., Dec. 7, killed one man and injured another.

An explosion in the powder magazine of the British military station at Calcutta, India, Dec. 7, killed 11 native soldiers and seriously injured 26 others. It is reported that the men were engaged in converting ball cartridges into blank cartridges at the time of the explosion.

An explosion of several hundred pounds of dynamite stored in a shed near the quarry of the Armfield & Cartwright Stone Co., three miles west of Portland, Ind., Dec. 7, shattered the windows of the Muncie & Portland Traction Co.'s power-house and of several other buildings in the vicinity. The explosion is believed to have resulted from overheating of the storage shed. No one was injured.

The nitroglycerin tanks of the Independent Powder Co. at Webb City, Mo., exploded Dec. 8, killing one man and injuring several others.

RAILWAY ACCIDENTS occurring between Dec. 6 and 15 resulted in the death of eleven people and the injury of about 25 others. A head-on collision between two passenger trains on the Atchison, Topeka & Santa Fe Ry. near Amarillo, Tex., Dec. 6, killed two men and seriously injured four others. The trains were under orders to pass at a siding near the point where the accident occurred. The collision is ascribed to frosty rails which made it difficult to stop the trains.

The engineer of the "Oriental Limited" on the Great Northern Ry. was found to be dead at his post by his fireman as the train was entering Minneapolis, Minn., Dec. 7. His skull was fractured and it is believed he was struck by some obstruction while leaning out of the cab window.

The "North Coast Limited" on the Northern Pacific Ry. was wrecked Dec. 9, 20 miles east of Bismarck, N. D. The train struck a broken rail while running at the rate of 50 mi. per hr. and the baggage and mail cars, three day coaches, two sleepers and the observation car left the track and were overturned, rolling down a 10-ft. embankment. The force of the drop was broken by a closely packed snow drift and, of the 200 passengers, none were killed and only eleven severely injured.

An accident on the tracks of the Pennsylvania R. R. in Chicago, Ill., Dec. 10, resulted in the death of two workmen and the injury of two others. While some heavy machinery was being loaded into freight cars in the yards near West Taylor St. and the Chicago River, a train collided with the cars and the machinery fell, crushing the men who were moving it into the car.

The boiler of a locomotive drawing a freight train on the Southern Pacific Ry. exploded Dec. 12 near Beaumont, Cal., killing three men and injuring one other. The locomotive and three cars were demolished.

A peculiar trolley-car accident occurred in Philadelphia, Pa., Dec. 14. A heavily loaded brick wagon became detached from its horses on the steep Midvale Ave. hill and rushed down the hill, striking a trolley car and partially demolishing it. Seven passengers were injured.

In a wreck on the railway in the Panama Canal Zone near Bas Obispo, Dec. 15, three men were killed and several injured.

HEADINGS MET IN THE SPRING GARDEN TUNNEL of the Western Pacific Ry. on Dec. 4. This is a single-track tunnel, 7,306 ft. long, near the California-Nevada State line and by rail about 300 mi. east of San Francisco. The Utah Construction Co. are the contractors.

TESTS OF A GAS WATER HEATER have been made at Washington, D. C., to determine the amount of carbon monoxide evolved under various conditions of operation. The tests were carried out by Prof. W. W. Skinner, of the Bureau of Chemistry, Department of Agriculture, and the heater first tested was the one believed to have caused the death of three persons in a Washington flat, as noted in our issue of Nov. 12. The following results are announced:

1. When the heater was run in a manner exactly similar to the manner it was run in the flat where it is supposed to have killed three persons, it gave off enough carbon monoxide to destroy life, as shown by analysis

of the escaping gases, analysis of the air of a room and experiments on a guinea pig.

2. When this particular heater was run in the most favorable way—i. e., with the air inlet entirely open and only a very small amount of water passing through the coil—enough carbon monoxide was evolved to pollute the atmosphere of an ordinary living room to such an extent as to be probably injurious to health.

3. When this particular heater was run in the most favorable way, to the air intake, but with a cold stream of water passing through the coils, enough carbon monoxide was evolved to probably cause death in a closed room.

Tests of a new heater of the same type gave a much smaller amount of carbon monoxide. It is evident that danger arises only when no flue is provided for carrying the products of combustion to the open air.

DIRECT-CURRENT FOR PENNSYLVANIA TUNNELS.—It has recently been announced that the Pennsylvania Tunnel and Terminal R. R. Co. had decided to use a third-rail direct-current traction system in the terminal zone from Newark, N. J., to Long Island City, N. Y. This is contrary to the general expectation that a high-tension alternating-current overhead system would be adopted. It is reported that the vague prospects for the installation of electric traction to Philadelphia or beyond, as given in press reports, have had no effect in determining the character of the system in this terminal zone. A protected third rail, for over-running contact, will carry 600 volts and transmission from a power station at Long Island City to substations will be made with 11,000-volt, 25 cycle, three-phase alternating current. The suburban trains will be arranged for multiple-unit control. The design of the locomotives for through trains has not been fixed.

THE MOST POWERFUL LOCOMOTIVES which have yet been designed for use on the Pennsylvania R. R. are to be built at the Juniata Shops at Altoona, Pa., where the construction of 15 of these locomotives has just been begun. The engine and tender complete and ready for service will weigh 384,000 lbs. The engine alone will weigh approximately 241,000 lbs., and the tender carry 7,000 gals. of water and 13½ tons of coal. The locomotive is of the consolidation type with one pair of truck wheels and four pairs of drivers. The diameter of the truck wheels is 33 ins. and that of the driving wheels 62 ins. Walschaert valve gears with 14-in. piston valves will control the steam distribution. The boiler is of the standard Belpaire type, having a minimum inside diameter of 76¾ ins.; it contains 465 2-in. tubes, 180 ins. long, giving a fire area through tubes of 7.77 sq. ft. The total fire grate area is 55.13 sq. ft., and the total heating surface is 3,839 sq. ft. The boiler is designed to safely withstand a pressure of 205 lbs. per sq. in. The total tractive power is 42,661. These new locomotives will differ from the type already in use mainly in the increased weight and size of drivers, giving a somewhat higher hauling capacity and greater speed.

THE MANHATTAN BRIDGE IS TO BE INVESTIGATED by an independent bridge engineer as the result of a request to the Mayor of New York City by the City Club. It is likely that Mr. Ralph Modjeski, of Chicago, Ill., will be appointed to make the investigation.

PERSONALS.

Mr. R. P. Stevens, of Allentown, Pa., has been elected President of the Pennsylvania Street Railway Association.

Mr. T. R. Flett, Superintendent of the Canadian Pacific Ry. at Brandon, Man., has been transferred to Saskatoon, Sask.

Mr. A. G. Perry has been appointed Manager of the British Columbia Electric Ry. Co. in North Vancouver, B. C., vice W. B. Bunbury, resigned.

Mr. Frederick Regan has been appointed Master Mechanic of the southern division of the Kansas City Southern Ry., with headquarters at Shreveport, La.

Mr. C. S. Maharg, Superintendent of the Canadian Pacific Ry. at Saskatoon, Sask., has been transferred to Medicine Hat, Alb., vice J. S. Lawrence, who has been assigned to other duties.

Mr. Azel Ames, Jr., Signal Engineer of the electrical zone of the New York Central & Hudson River R. R., has resigned to enter the service of the Kerite Insulated Wire & Cable Co. in New York City.

Dr. Cyrus Northrop, President of the University of Minnesota, has presented his resignation to take effect at the close of the present college year. He will at that time have completed his 25th year as President of the University.

Mr. Wm. M. Torrance, heretofore a contracting engineer at No. 253 Broadway, New York City, has associated himself with the Merrill-Ruckgaber-Fraser Co., Contracting Engineers, 50 Church St., New York City, as Construction Engineer.

Mr. R. E. Comfort has been appointed General Superintendent of the National Lines of Mexico, succeeding Mr. F. W. Baldwin, deceased. Mr. Comfort was formerly Division Superintendent of the Interoceanic Ry. at Puebla, Mex., and will be succeeded in that position by Mr. J. A. Naugle.

Mr. George C. Lloyd, Secretary of the Institution of Electrical Engineers of Great Britain, has been appointed Secretary of the Iron and Steel Institute to succeed Mr. Bennett H. Brough, whose death was recorded in our issue of Oct. 22, 1908. Mr. Lloyd acted as Mr. Brough's assistant from 1900 to 1904.

Mr. Alexander Galloway, formerly an inspector of train and station service of the Southern Pacific Co. at San Francisco, Cal., has become Superintendent of the Ocean Shore Ry. Before entering the service of the Southern Pacific Co., Mr. Galloway was for eleven years Superintendent of the Cincinnati, Hamilton & Dayton Ry.

Mr. George B. Agnew, Assoc. Am. Inst. M. E., has been elected President of the North Star Mines Co., to succeed Mr. James D. Hague, whose death was recorded in our issue of Aug. 6, 1908. Mr. Agnew's place as Vice-President of the company will be taken by Mr. Sidney M. Colgate. Dr. James Douglas, Hon. M. Am. Inst. M. E., has become a director of the same company, succeeding Mr. Jacob W. Pierce, resigned.

Mr. Lincoln Bush, M. Am. Soc. C. E., Chief Engineer of the Delaware, Lackawanna & Western R. R., has resigned and will enter upon private practice as a consulting engineer. Mr. G. J. Ray, formerly division engineer at Scranton, Pa., and recently employed by the contractor on construction work for the Lackawanna cut-off in New Jersey, will succeed Mr. Bush as Chief Engineer.

Mr. Alexander Pourcel, an eminent French metallurgist, and a member of the Iron and Steel Institute, has been awarded the Bessemer Gold Medal. This medal is awarded annually by the Council of the Institute. Mr. Pourcel was chosen this year as the recipient on account of his investigations in the manufacture of ferro-manganese and his work on the thermal reactions involved in the manufacture of iron and steel.

Mr. Walter W. Patch, M. Am. Soc. C. E., for the past four years employed as Constructing Engineer with the U. S. Reclamation Service on the Belle Fourche Project, S. D., has been transferred to take charge of the Orland Project, Cal. Before his connection with the U. S. Reclamation Service, Mr. Patch was for eleven years with the engineering corps constructing additional water supplies for the cities of Boston and New York.

Mr. C. M. Ingersoll, M. Am. Soc. C. E., Chief Engineer of the Department of Bridges, New York City, has resigned, but will continue as a consulting engineer in the department. Mr. Kingsley L. Martin, M. Am. Soc. C. E., will succeed Mr. Ingersoll as Chief Engineer. Mr. Martin was formerly Engineer in Charge of the Brooklyn and Williamsburg Bridges. He is a graduate of the Stevens Institute of Technology, and is a son of the late C. C. Martin, for many years Chief Engineer of the Brooklyn Bridge.

Obituary.

Charles M. Fosdick, Assistant Traffic Engineer of the Central Union Telephone Co., of Indianapolis, Ind., died at his home in Fitchburg, Mass., Dec. 5.

Dennis Burkhalter, Division Superintendent of the Southern Pacific Ry. at Sacramento, Cal., died Dec. 2 at a hospital in that city. He was 68 years old.

Augustus F. Rodgers, Assistant Superintendent of the U. S. Coast and Geodetic Survey, died Dec. 9 at his home in San Francisco, Cal. He had been 61 years in the Government service.

Herman K. Viele, who for several years practiced as a civil engineer in Washington, D. C., died in New York City Dec. 14. Mr. Viele began the study of literature and art eight years ago and is best known as an author of fiction. He was born in New York City in 1856.

Frank W. Baldwin, General Superintendent of the National Lines of Mexico, died Dec. 4. Mr. Baldwin was formerly General Superintendent of the Central Vermont Ry., with which he was associated for several years before entering the service of the National Lines in 1905.

Marvin Kent, the first President of the Atlantic & Great Western Ry., died at his home in Kent, Ohio, Dec. 10. Mr. Kent was born in Portage Co., Ohio, in 1816. He became interested in the Atlantic & Great Western Ry. in 1850, and is said to have driven the last spike when the road was completed in 1864. He retired from active business soon afterward, when this railway became a part of the Erie system.

Percy C. Hamilton, President of the Atlas Clay Material Co. and Vice-President of the United States Clay Mfg. Co., died Dec. 9 in the Manhattan State Hospital for the Insane at Central Islip, Long Island. Mr. Hamilton was a member of the Pittsburg, Pa., Chamber of Commerce and of the American Ceramic Society. He was 44 years old and had been confined in the hospital three weeks at the time of his death.

Oliver Wolcott Gibbs, Rumford Professor and Lecturer on the Application of Science to the Useful Arts, Emeritus, of Harvard University, died at his home in Newport, R. I., Dec. 9. Dr. Gibbs was born in New York City in 1822 and graduated with the degree of A. B. from Columbia University in 1841. In 1849 [illegible] became Professor of Physics and Chemistry at the [illegible] City of New York and continued in the [illegible] in 1863, he was chosen as Rumford P[illegible] vard.

Charles D. Elliot, the first City Engine[illegible] Mass., died at his home in that city Dec[illegible] was born in Foxboro, Mass., in 1837, and [illegible] the Hopkins Classical School in Cambrid[illegible] erville High School. During the Civil W[illegible] ployed in the service of the U. S. Gover[illegible] engineer. He became City Engineer of So[illegible] and served till 1875. A few years later h[illegible] of the surveys for the Cape Cod Canal [illegible] continued in active practice as a consulti[illegible]

Warren E. Hill, M. Am. Soc. M. E., P[illegible] Continental Iron Works of Brooklyn, N. [illegible] in New York City. Mr. Hill was born [illegible] City in 1835. In 1852 he entered the [illegible] Allaire Iron Works in Newark, N. J., and [illegible] that company six years. In 1858 he becam[illegible] ent in charge of the installation of the D[illegible] Water-Works and retained that position un[illegible] he returned to the East and became assoc[illegible] Continental Iron Works in Brooklyn. H[illegible] Vice-President of that company in 1888 and [illegible] to the presidency in 1907. Mr. Hill is [illegible] the design of the machinery and engines of [illegible] "Monitor," which defeated the "Merrimac" [illegible] Roads.

ENGINEERING SOCIETIES.

COMING MEETINGS.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Dec. 28-29. Annual meeting at Pittsburg, Pa. Secy., John C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Dec. 28-Jan. 2. Annual meeting at Baltimore, Md. Secy., L. O. Howard, Smithsonian Institution, Washington, D. C.

NATIONAL ASSOCIATION OF CEMENT USERS.
Jan. 11-16. Annual convention at Cleveland, Ohio. Secy., Geo. C. Wright, Harrison Bldg., Philadelphia, Pa.

IOWA ENGINEERING SOCIETY.
Jan. 13-14. Annual convention at Waterloo, Iowa. Secy., A. H. Ford, Iowa City, Iowa.

MICHIGAN ENGINEERING SOCIETY.
Jan. 12-15. Annual convention at Ann Arbor, Mich. Secy., Alba L. Holmes, 574 Wealthy Ave., Grand Rapids, Mich.

INDIANA ENGINEERING SOCIETY.
Jan. 14-16. Annual convention at Indianapolis, Ind. Secy., Charles Brossman, Union Trust Bldg., Indianapolis, Ind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
Jan. 19. Annual meeting at New York City. Secy., W. M. Mackay, P. O. Box 1818, New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 20. Annual meeting at New York City. Secy., Charles W. Hunt, 220 West 57th St., New York City.

OHIO ENGINEERING SOCIETY.
Jan. 26-28. Annual convention at Columbus, Ohio. Secy., Paul Hansen, Harrison Bldg., Columbus, Ohio.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.
Jan. 27-29. Annual meeting at Chicago, Ill. Secy., E. E. R. Tratman, 1636 Monadnock Block, Chicago.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 28. Annual meeting at Toronto. Secy., C. H. McLeod, 413 Dorchester St., W., Montreal, P. Q.

NATIONAL BRICK MANUFACTURERS' ASSOCIATION.
Feb. 1-6. Annual convention at Rochester, N. Y. Secy., T. A. Randall, Indianapolis, Ind.

WESTERN RAILWAY CLUB.—At the meeting held in Chicago, Ill., Dec. 15, two papers were presented, as follows: "The Abuse of the M. C. B. Assn. Repair Card," J. J. Hennessey (C., M. & St. P.); "Life of Side Sheets of Wide Fire-Boxes," C. A. Selcy (C., R. I. & P.). The first paper discussed the annoyance occasioned by the failure of car-shop employees to apply the repair cards and suggested means for enforcing better discipline in this direction.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—Among the papers announced for the first annual meeting, Dec. 28-29, at Pittsburg, Pa., are the following: Dec. 28, "Technical Coal Analysis," Edward Gudeman; "The Chemical Aspect of Impurities Which Cause Scale and Corrosion of Steam Boilers," J. C. William Greth; "The Examination of Flue Gases in Boiler Tests," H. August Hunicke; "The Utilization of Low Grade Fuels in the United States," O. K. Zwingenberger; "Work of the U. S. Government Fuel-testing Plant at Denver, Colo.," A. W. Belden; "Heating of Industrial Furnaces with Pulverized Fuel," Richard K. Meade. Dec. 29. "Modern Electrical Resistance Pyrometry," Edwin T. Northrup; "The Sanitary Condition of the Southern End of Lake Michigan," J. H. Brewster; "Cement Manufacturing Methods," J. G. Dean. For some unexplained reason, no mention is made in the complete program now at hand of the paper by Mr. Gayley—which was mentioned in a preliminary announcement published in this column Nov. 26.

ENGINEERING LITERATURE

Supplement to ENGINEERING NEWS. 220 Broadway, New York, December 17, 1908.

CONTENTS.

REVIEWS:
Sewer Construction. Reviewed by Harrison P. Eddy. 689
Coal 690
Modern Practice in Mining..... 690
Handbuch zur Geschichte der Naturwissenschaften und der Technik 690
Lathe Design for High and Low-Speed Steels. Reviewed by Carl G. Barth..... 691
Ueber den Querschnitt der Staumauern..... 691
Engineering Work in Towns and Cities..... 691
Elementary Applied Mechanics..... 691
Patents as a Factor in Manufacturing..... 691
Surveyor's Hand Book..... 691
Concrete System. (Contributed.) 692
Theory and Design of Reinforced-Concrete Arches. 692
The Modern Asphalt Pavement..... 692
Sewers and Drains 692
Graphical Determination of Earth Slopes, Retaining Walls and Dams. Reviewed by Charles L. Crandall 693
Erecting Work—Pipes and Piping—Knocks and Kinks—Pumps—Shaft Governors 693
A Text-Book on Roads and Pavements. Reviewed by S. Whinery..... 694
How to Understand Electrical Work..... 694
Differential and Integral Calculus..... 694
Cement Laboratory Manual..... 694
Machine Shop Calculations..... 694
Railroad Construction 694
Railroad Engineering 694
Transportation by Water..... 695
The Temperature-Entropy Diagram..... 695
The Design and Equipment of Small Chemical Laboratories 695
Heating and Ventilating..... 695
Tables for Calculating Sizes of Steam Pipes for Low Pressure Heating..... 695
PUBLICATIONS RECEIVED 696

REVIEWS.

Lectures on Sewer Construction.

Reviewed by HARRISON P. EDDY,* M. Am. Soc. C. E.

SEWER CONSTRUCTION.—By Henry N. Ogden, Assoc. M. Am. Soc. C. E., Professor of Sanitary Engineering, Cornell University, Special Assistant Engineer, New York State Department of Health. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ × 9½ ins.; pp. 335; 192 illustrations in the text. $3.

As is very clearly set forth in the preface, this book is a compilation of a course of lectures given in the College of Civil Engineering at Cornell University and is intended by the author to be supplementary to his Sewer Design published in 1899. This, together with the fact that the book is intended primarily for "students entering upon the investigation of sewer construction" and "practicing engineers who may have occasion to take up the matter of sewer work for the first time," accounts for the elementary nature of some of the chapters.

The first chapter deals with the materials and methods of manufacture, and gives certain average data relating to thickness of walls, dimensions of bells, and sizes of pipe ordinarily manufactured. The comparative merits of the various lengths of pipes and of standard and deep and wide socket pipe are discussed. It is unfortunate that the author fails to discuss the methods of inspection of vitrified pipe—a subject often causing the engineer much anxiety and no little perplexity.

Continuing the discussion of "sewer pipe," the author quotes extensively from current literature upon the strength of vitrified pipe, giving in tabular form considerable data derived from experimental tests. On page 16, he refers in detail to the well known tests by Mr. Barbour at Brockton, Mass., but is in error in stating that Mr. Barbour was then City Engineer; Mr. F. Herbert Snow was City Engineer and the tests were made under his direction, although this fact should not detract in the slightest from the credit due Mr. Barbour for his very careful and novel work, which is conceded to be of great value.

The discussion of methods of making joints and of the different materials used is very complete, although it seems to the writer that much more might be said in favor of the sulphur and sand joint. The difficulty, suggested by the author, in securing the correct temperatures for the sulphur-sand mixture has been largely overcome in recent years, by the use of the gasolene furnace, so that a laborer of ordinary intelligence can conduct this operation without difficulty.

The chapter upon brick sewers is very interesting and deals with several different types of design. The description of the use of invert blocks occupies rather more space than would seem to be warranted by present practice, especially in view of the many objections to their use which the author clearly explains. The comparative merits of the circular and egg-shaped sewers are touched upon and several pages are devoted to the discussion of the proper thickness for the masonry. Here again the author quotes from Mr. Barbour's valuable experimental work and cites a number of examples of sewers built with various thicknesses of brickwork. A number of cuts illustrate different types of sewers and are of especial value because they illustrate sewers which have actually been built. The chapter closes with a description of bricklaying, in which the author states that a good man will lay from 2,500 to 4,000 brick a day in large sewer. To New England engineers this would seem like a bit of history—a glimpse into the past, before the eight-hour day and modern ideas of a fair day's work had been evolved. We believe that the author would be on safer ground if he placed the limits at 1,500 to 3,000, although no doubt there are still instances of 4,000 as a day's work, but they are becoming rare. The author might well have pointed out the fact that a mason can lay many more brick—perhaps double the number—in the arch than in the invert.

The author naturally follows his discussion of brick sewers by a discussion of the use of concrete in sewer construction, devoting three chapters to "Concrete Sewers," "Concrete and Brick Sewers," and "Reinforced-Concrete Sewers," respectively. The opening pages are devoted to the manufacture and use of cement or concrete pipe, the Chenoweth and Ransome processes being described in some detail. On pages 64 and 65 a number of typical cross-sections are given, with formulas for determining the thickness of the wall, but as the value of the constant, "C," is given only for minimum conditions, they are of little value. The chapter devoted to brick and concrete sewers gives numerous illustrations drawn from sewers actually constructed and shows the transition stage between all brick and all concrete construction. The question of the ability of concrete to withstand erosion is raised and passed with the statement that it is "a fear entirely unfounded." It is unfortunate that this most important question, as well as that of the leakage or seepage of water through concrete, are not fully discussed and references given to experimental tests and to results of actual experience, for there are concrete inverts in existence which have been in use for many years.

Very little attention is paid to the design or construction of forms and centers,—a most important feature of the construction of sewers and one which the engineer is constantly required to pass upon, and which causes no little anxiety on his part.

Upon reinforced-concrete sewers the author makes few comments except that "the saving of expense is very great," especially upon the larger sizes, and to point out the porosity of the concrete as a disadvantage. The examples drawn from practice are very good and should be helpful to the student, who will also welcome the data regarding proportions of the various mixtures used in making the concrete. A few hints as to the best methods of shaping and holding the steel in place during the placing of the concrete, would have added value to this chapter, as this is one of the most perplexing difficulties which the engineer encounters, either in construction done under his direct supervision, or in securing proper work from contractors. The finish to be obtained is also a matter of much importance in sewer construction, and could have been touched upon to advantage, especially to an extent sufficient to show the character of work which should be required.

The subject of manholes is very fully treated, the author having given his views upon the best methods of construction, proper dimensions, and frequency with which they should be used. A number of very good cuts illustrate methods of design to meet different conditions and considerable attention is given to sewer junctions built in manholes, and manholes in or near which drop inlets or connections are required. A number of practical hints are given regarding the design and construction of frames and covers, including locking devices, perforations for ventilation and dust pans. The author also describes and illustrates lamp holes, although discouraging their use.

The subject of catch basins is quite completely discussed, and the cuts showing numerous types are interesting and instructive, especially in showing what not to build. On the general question, the position is taken that in many cases catch basins are unnecessary, direct connections with the sewers being satisfactory and preferable for several reasons. The arrangement and number of basins required under different topographical conditions are discussed in detail, as are also the different styles of covers, gratings and traps. The chapter concludes with a discussion of the frequency with which basins should be cleaned, but there is no discussion of methods and cost of cleaning—a most important subject.

Both true and so-called "inverted" siphons are fully discussed with descriptions of a few true siphons, and of about a dozen "inverted siphons," most of which have been built and are now in use. The examples drawn from constructed siphons include both those receiving sewage and those upon combined systems of sewerage, and therefore receiving sewage and storm water.

Screens, so important an adjunct to pumping and disposal plants, are described in a very interesting manner, with illustrations of four styles; the rectangular mesh; the perforated plates; the vertical rods; and chains or links. Instances of the use of hand-cleaned screens and those cleaned mechanically are cited, with brief descriptions of the apparatus for cleaning the latter.

After briefly discussing the uses and necessity of storm-water overflows and regulators, three types of overflows are described. These are the leaping weir, overflow weir and mechanical regulator. A number of examples of the different classes are given, with descriptions of several different mechanical devices for regulating the flow of sewage from the common sewers into intercepters of relief sewers. The use of such a regulator for admitting creek water into a sewer for flushing purposes is also explained. A very short chapter upon bell mouths gives a number of interesting examples which illustrate different methods of construction.

The subject of foundations in soils not suitable for the construction of the barrel of the sewer directly upon them is quite fully discussed from a practical standpoint. Descriptions are given of the use of platforms, cradles and of refilling with gravel and concrete below subgrades. Under pile foundations, the saddle pile used by the late Col. Waring, the single row of piles for small structures and bents of several piles, as provided for the larger structures, are described and illustrated by several very good drawings. The use of concrete piling and the placing of the masonry of the sewer directly upon the piles, without intermediate timber flooring, has unfortunately been omitted. There is a full and very interesting description of the building of an embankment for the Boston Main Drainage Outfall Sewer from Squantum to Moon Island, dealing particularly with the amount and rate of settlement of fill, careful measurements of which were taken over a period of nine years.

Sewer outfalls, which have been built under many different conditions, are described and illustrated by drawings. In this chapter the author deals with some failures from which the student can learn fully as much as from a study of the structures which have proved successful. The range of outfalls described is great, being

* Of the firm of Metcalf & Eddy, Consulting Engineers, 14 Beacon St., Boston, Mass.

from mere retaining walls about pipe sewers and built above water, to large submarine structures like that off Nut Island, which delivers the flow from the Metropolitan High Level Sewer into Boston Harbor.

A brief discussion of the various methods of constructing house drains, deals with the comparative merits of the Y and T branches, the use of eighth bends at branches, chimneys, and the frequency with which branches should be left for house drains.

Under the caption "Surveying," are given many hints as to methods to be followed in locating the line of the sewer upon the ground, giving elevations for the laying of the pipe, and referencing branches left for connection of house drains. A sample page from the author's note book is also reproduced, furnishing an illustration of a convenient method of keeping notes.

There is also a very brief, and it would seem inadequate, description of the method of preparing monthly estimates—a most important subject which might well have been considerably amplified.

Because of the fact that engineers are frequently called upon to actively direct the work of constructing sewers, as well as of design and giving of lines and grades, the author has included a chapter upon trenching. Under this heading, he deals with the width of trench to be adopted under various conditions; the methods in common use of sheeting and bracing; the comparative merits of the different trench machines upon the market; and finally devotes several pages to methods of drilling and blasting, giving also certain rates at which drill holes may be put down in different kinds of rock.

The chapter devoted to estimates and costs gives a very thorough and detailed analysis of the more common items required for sewer construction. Extensive quotations are made from current literature to give the reader some idea of probable cost of work, and frequent emphasis is laid upon the certainty of variable conditions which will surely affect costs. The reader is thus very wisely warned not to depend too much upon published costs of work done, although given enough illustrations to guide him in a general way. It would certainly seem that the figures given, as indicating the cost of brick masonry, are very low and might mislead the reader and the calculation on page 270 is wholly unintelligible.

In the closing chapter, a form of contract and specifications has been reproduced with the comments of the author upon most of the articles and sections. As a whole, the form appears to be typical of good practice, although, as is clearly pointed out in the various comments, many of the paragraphs might be much improved. Perhaps greater assistance can be rendered the student, however, by inserting these weak clauses and pointing out their defects, than by attempting to improve them.

In retrospect, it appears that "Sewer Construction" is a valuable addition to the literature upon this subject. The text is replete with practical hints and suggestions.

The book is well written and well indexed, neatly bound and the presswork is pleasing. There are comparatively few errors in the text. The numerous (102) cuts are mostly from drawings and well illustrate current practice and the suggestions of the text. It is worthy of mention that nearly all drawings reproduced are of works actually constructed and not of designs worked out in the classroom and never submitted to the practical test of use.

As already explained, this book is written primarily for the student and the engineer confronted with these problems for the first time; but in spite of the elementary nature of much of the subject matter, it is a book which engineers who have been designing and building sewers for many years can well afford the time to read, and should have at hand for reference.

It may not be out of place to add that while the student will find many of his questions answered in this volume, many others will be brought home to him by the hard knocks of actual practice.

Coal and Coal Mining.

COAL.—By James Tonge. New York: D. Van Nostrand Co. Cloth; 5⅛ × 8¼ ins.; pp. 275; 10 plates and 46 text illustrations. $2, net.

The contents of this book are related to two widely different lines of study of the coals of the world. The first line has to do with the origin and location of deposits and the second deals with economic values and industrial applications. The matter is written from the British standpoint and naturally emphasizes those points which a British subject would be most apt to appreciate. One is led to believe, at first, that the book was written for general perusal, but this view is apt to be changed later to include persons of a scientifically inclined mind, or at least those not dismayed at formidable arrays of technical terms. The book, as a whole, should be easy reading for an engineer.

The history of English coals, the geological occurrence of coals generally and theories of seam formation form short introductory chapters. The first important section is devoted to the fossils of coal beds and to the botany of the coal-era plants. In discussing fauna and flora the author is so extremely technical, perhaps necessarily, that a considerable insight into biology is needed before he can be very intelligently followed.

The coal fields of the British Isles are geologically described, and to the greatest extent of any particular group taken up. The American deposits seem to be next in the author's idea of relative importance. The fields of Europe, Asia, Africa and Australasia are taken up by countries in a brief way.

After this the common classifications of coals are reviewed; those by chemical composition, by industrial (heating) value and by physical characteristics are discussed. The author herein briefly describes the effects of different percentages of moisture, ash, volatile matter, fireclay, nitrogen and sulphur and dwells on the coking power, the strength or hardness and the specific gravity of different coals. Under the title "Foreign Coals and Their Values," are listed the important characteristics affecting industrial values of coals of the United States, Canada, Germany, and all the other European countries, of China, Manchuria, Japan and Australia.

Another important section is on the production of heat from coal. This part contains some elementary chemistry and a simple exposition of calorimetry, boiler practices, losses in burning coal and in mining it. The final large division of the subject matter deals with the preparation of coals for market—with the sizing, screening, cleaning, washing, briquetting and coking processes. The methods and machinery described are English and German. The author draws some comparisons of English and German colliery towns that are tributes to the ability of the German engineers in preventing unsightly and noxious wastes. The book closes with a list of the maritime coaling stations of the world.

The author's data seem accurate, up to date and sufficient to illustrate his argument. Authorities quoted are freely credited. The statements are clear and concise; the arrangement is pleasing. Some parts of the book will appeal to certain groups of readers more than to others, but those familiar with one part will find something instructive about developments in other less familiar phases of the coal industry.

MODERN PRACTICE IN MINING.—Vol. I.: Coal, Its Occurrence, Value, and Methods of Boring. By R. A. S. Redmayne, M. Inst. C. E., M. Inst. M. E., His Majesty's Chief Inspector of Mines, etc. London, New York and Bombay: Longmans, Green & Co. Cloth; 5½ × 8¾ ins.; pp. 199; 123 illustrations in the text, and one large folding table. $2, net.

This volume is put out as the first of a series of comparatively small books which shall constitute a complete library on modern practice in mining. It is purposed to make each volume take up some particular phase of mining and not to attempt to cover in any volume a very broad field.

This volume in hand, after some forty odd pages of general matter on coals, passes to bearing or core drilling as the main topic. The volume may then be considered as [illegible] exposition of present European and Americ[illegible] practice of small-hole boring as a part of m[illegible] exploration.

The author classifies coals acc[illegible]g to the relative proposition of volatile h[illegible]rbons to fixed carbon. He lightly passes o[illegible]rmations containing coal deposits and briefly [illegible]alogs the British coal fields by groups. Th[illegible]rieties of coals are only very generally d[illegible]ed. The author shows a few pictures [illegible]ssil coal plants from earlier works, but say[illegible]ttle about them. Proximate analyses, specifi[illegible]avity and calorific-value determinations are ex[illegible]ined, and then the author comes down clos[illegible] mining methods.

First, in this part, he discusses [illegible] application of a knowledge of geology to [illegible]ining and tells how formations have to be stu[illegible]d. After this is a chapter, on prospecting [illegible] coal, in which the use of small bore holes [illegible]s discussed in some detail. All the succeeding ch[illegible]pters unfold the author's purpose of setting forth modern boring or drilling practice.

HANDBUCH ZUR GESCHICHTE DER NATURWISSENSCHAFTEN UND DER TECHNIK.—In Chronologischer Darstellung. By Ludwig Darmstaedter, with the cooperation of R. du Bois-Reymond and D. C. Schaefer. Second edition, revised and enlarged. Berlin, Germany: Julius Springer. Cloth; 6¼ × 9½ ins.; pp. 1,262.

Whoever concerns himself with more than the mere present, whoever finds interest or value in a chronology of scientific and industrial invention or discovery—and that should include every educated human being—will welcome the above-named volume. It is an excellent compilation in every respect, and stands as a monument to its authors. Its comprehensive nature and its concise accuracy of statement are alike admirable. If it is not as good as might be conceived possible, at least it is as good as three men can well produce.

The arrangement is purely chronological. Dates are indicated in the margin, and under each year are set in separate paragraphs the important discoveries, inventions or improvements made known in that year. In each paragraph the name of the person primarily concerned is printed in heavy type, and the items for each year are ordered according to the alphabetical sequence of the names. Cross-references, an index of names and an index of subjects make the contents readily accessible.

It might be expected, perhaps, that American achievements (of the last century or so) would not be as fully represented as those of Europe. This is the case to a degree, in the field of technological improvement at least. But American work is fully enough represented to prove the authors' aim at absolute impartiality as between the different countries. And after all, those fields in which we seem to discover a relative undervaluation of American work are just those in which no reasonably accurate or complete history can possibly be expected.

REPORT ON THE INSTALLATION OF AN EXPERIMENTAL DRAINAGE SYSTEM.—At the Northwest Experiment Farm, University of Minnesota, Crookston, Minn. (Bulletin No. 110, Minnesota Experiment Station.) William Robertson, Superintendent of Farm. St. Paul, Minn.: The Agricultural Experiment Station (St. Anthony Park). Paper; 5¾ × 8¾ ins.; pp. 99; text illustrations and one folding map.

Although the drainage work here described is spoken of as experimental, it appears to have been carried out on practical lines. In fact, its chief variation from other drainage work seems to have been in the careful way in which the work was done, the detailed figures of cost given, and the use of various kinds of material and appliances. The surveys were made under a co-operative agreement between the University of

DO YOU KNOW

what made the Quebec Bridge fall? Why dams fail? Why reinforced concrete structures fail? Get "A Minority Report on the Quebec Bridge Disaster" (20 cents); "Godfrey's Concrete" ($2.50), and "Godfrey's Tables" ($2.50), and you will have some information and data not published anywhere else. Send to the author and publisher.

EDWARD GODFREY, Monongahela Bank Building, Pittsburg, Pa.

Minnesota and the Office of Experiment Stations, U. S. Department of Agriculture. The preliminary surveys and the installation of the system were carried out under the direction of Mr. John T. Stewart, Drainage Engineer of the national government department just named.

Lathe Design.

Reviewed by CARL G. BARTH,* M. Am. Soc. M. E.

LATHE DESIGN FOR HIGH AND LOW-SPEED STEELS.—A Treatise on the Kinematical and Dynamical Principles Governing the Construction of Metal Turning Lathes. By John T. Nicolson, M. Inst. C. E., Professor of Mechanical Engineering in the University of Manchester and in the Manchester Municipal School of Technology, and Dempster Smith, Assoc. M. Inst. M. E., Assistant-Lecturer and Demonstrator in the University of Manchester, Lecturer in Machine Design in the Manchester Municipal School of Technology. London, New York and Bombay: Longmans, Green & Co. Cloth; 6¼ x 10 ins.; pp. 402; 255 illustrations, mostly in the text, and 9 diagrams. $6.

In this extensive treatise, covering some 400 large pages, the authors have attempted to lift the designing of metal-cutting lathes to a high level of scientific engineering, and every phase of the subject has apparently had its share of careful attention, even to the limitations put upon the practical designer by commercial considerations.

The strains and stresses in the principal parts, such as the spindle, back shaft and gears of the head-stock, are all carefully investigated, and mathematical formulas established for their proper proportioning; and so also the stresses in the bed itself, which usually receive but scant consideration by the practical designer. The subject of power requirements is also treated in an exhaustive manner.

The maximum size of cut to be taken by a lathe on a piece of work of a diameter which bears a certain ratio to the maximum swing of the lathe, in connection with the cutting speed at which this cut may be taken on a material of a certain degree of hardness, is made the rational basis of these investigations and the numerous formulas and diagrams developed.

The matter of the strength and the wearing qualities of gear-wheels has been taken up in the light of the most recent German experiments and investigations, and so also the matter of the wearing qualities of bearings under imperfect lubrication, and the conditions for perfect lubrication, under which all wear between a journal and its bearing is practically eliminated.

Very valuable features of the book are the illustrations and descriptions of the driving gears and feed motions used on a great number of representative lathes made by prominent manufacturers both in Europe and this country.

Considerable space is devoted to the consideration of the spindle speeds, both the proper limitations of the extreme speeds, and the constant ratio of any two successive speeds, which together determine the total number of desirable speed changes.

This certainly is a very important part of the subject, though one that is capable of a far simpler presentation than the exceedingly mathematical one adopted by the authors; and it is feared that the reader who has not already found his own way of getting his range of spindle speeds into a geometrical series will not have the patience to get what he is looking for from the treatise in this book.

It is also to be regretted that the authors have employed rules for the pulling power of belting that are contrary to all accepted notions in this country on this important subject. It is therefore not likely that any of the formulas developed on these rules as a basis will be accepted as of any other value than pointing a way to the development of more acceptable ones based on belt rules that have a rational foundation.

For Americans it is also very disappointing that the rules used for tool pressures, and the formulas used for cutting speeds in terms of the cut, are those derived from the comparatively few experiments made in England and Germany, and not those given in F. W. Taylor's paper, "On the Art of Cutting Metals," which is the accepted standard in this and most other countries, and in which the formulas given were derived by Mr. Taylor and his associates from thousands of experiments made during a term of years.

In view of the latter remarks, the book cannot be considered in all respects an unqualified success, though it shows throughout painstaking effort; and more particularly as numerous American engineers and machine designers are aware of the exceeding simple manner in which Mr. Taylor's still active associates handle the subject of speeds, feeds, and power for lathes and other machine tools, by means of slide-rules embodying the formulas entering into the solutions of the problems implying these elements.

*Consulting Engineer, 1941 North 33d St., Philadelphia, Pa.

UEBER DEN QUERSCHNITT DER STAUMAUERN.—By Ferd. Platzmann. (Fortschritte der Ingenieurwissenschaften, Second Series, Part 20.) Leipzig, Germany: Wilhelm Engelmann. Paper; 7¼ x 11 ins.; pp. 63; 2 plates and 53 text illustrations. 2.40 marks; American price, $1.

The subject of high masonry dams, on which so much has been written in the past few years, is attacked from a new point of view by the present author. He does not follow some other recent investigators in casting doubt on the assumption that the normal stresses on horizontal sections are distributed according to a straight-line law; but, accepting this assumption, he urges that these normal stresses are not a final criterion of safety, and that this should be sought in the "principal stresses," which exceed the normal stresses whenever the latter are accompanied by horizontal shear. This asserts no new fact, of course, but the means which the author employs to compute the principal stresses are novel. He starts from the consideration that the lines of principal stress near the faces are parallel to the faces of the dam. This permits the calculation of their amount in terms of the normal stress, the horizontal shear and the slope of the face, the formulas being derived from the equations of equilibrium of a triangular element of the dam at the face. The results are, briefly: (1) that the maximum compression at the down-stream face may exceed the vertical compression by a respectable amount, where the slope of the face becomes considerable, and (2) that the principal stress at the up-stream face may be tension (along the face) unless the vertical compression at this point has a definite value, of considerable amount at points of flat slope. He concludes that in order to avoid tension, which might produce horizontal cracks in the water face, the line of pressure must remain within a narrower zone than the middle third.

The argument is interesting because of its novelty and because it contains an element of truth. But the obvious inaccuracy of some of its assumptions vitiates the conclusions and deprives them of practical value as amendments of the common method of calculation.

ENGINEERING WORK IN TOWNS AND CITIES.—By Ernest McCullough, Author of "Reinforced Concrete," "The Business of Contracting," etc. Second edition. Chicago and New York: The Myron C. Clark Publishing Co. Cloth; 5¼ x 8 ins.; pp. 502; 44 illustrations in the text. $3, net.

In the first edition of this book (reviewed in Engineering News, Dec. 13, 1906), the author divided his subject-matter into two parts, for the technical and for the non-technical reader, placing the two treatments of each subdivision at opposite ends of the book. In this second edition, just issued, this scheme has been abandoned and all the matter on any one subject is to be found at one place. While removing one of the assumed virtues of the old edition—the benefit of the book to non-engineering city officials—this scheme tends much toward the general betterment of the work and makes it more in keeping with its title. Various other changes might be noted, but they are of a somewhat minor character. The general impression of the second edition is that, while not differing materially in its matter from the first, the arrangement is much more useful and there is an absence of a certain colloquial style, brought about probably by the removal of many not altogether appropriate chapter heading quotations. The presswork in the second edition is much better than in the first.

ELEMENTARY APPLIED MECHANICS.—(Statics). Introducing the Unitary System. By Alexander Norwell, Principal of Greenock Technical School and Watt Memorial Engineering and Navigation College, Greenock. London, New York and Bombay: Longmans, Green & Co. Cloth; 4¾ x 7½ ins.; pp. 242; 218 illustrationss in the text. 90 cts.

The calculation of force and work relations for the "simple machines" of physics constitutes the principal subject of this textbook. The strength of shafts and beams is also discussed, but without proof of the formulas, so that the reader must take them on faith. The chief value of the work, therefore, lies in affording practice and guidance in the simpler class of computations involving force and work. The author makes a special point of the desirability of introducing into every numerical calculation the units or denominations of the several terms, and carrying out the same operations with the denomination as are required for the members, so as to give automatically the denomination of the result as well as its numerical value. He applies this method in all the numerical exercises worked out in the text, and as the preface implies he regards it as the book's chief claim to notice. We are inclined to share his opinion in this respect.

PATENTS AS A FACTOR IN MANUFACTURING.—By Edwin J. Prindle, of the New York Bar. New York: The Engineering Magazine. Cloth; 5 x 7½ ins.; pp. 134. $2.

The author of this volume disclaims any intention of making the inventor or the manufacturer his own patent attorney. His book, therefore, omits any consideration of the fine legal technicalities of patent law, but instead takes up the broader subjects with which every manufacturer or engineer having to do with patents ought to be reasonably familiar. While many of the points covered in the book have been published in the advertising pamphlets which are distributed gratis by some of the enterprising firms of patent attorneys, we do not recall anywhere so systematic and complete a presentation of patent law for the layman in small compass as is here given. Of the seven chapters of the book, Chap. IV., relative to infringements, and Chap. VI., on the patent relations of employer and employee, are particularly worthy of commendation for their usefulness to engineers. The book as a whole, however, is a meritorious and useful one.

PENNY ENGINEER

Data for Engineers and Draftsmen

On Standard Index Cards, 3 x 5 inches

Series No. 3.

Reinforced Concrete Slabs, Rivets,
Timber Beams,
Decimal Equivalents of Feet and Inches, etc.

Price of above Series of 10 Cards 10c., and 2c. for mailing
Circular upon receipt of 2c. postage

PENNY ENGINEER

Room 719, at 167 Dearborn Street, Chicago, Ill.

Branch's Chart Book
and
Charts in Colors

showing the development of the STEAM BOILER, the STEAM ENGINE and the ELECTRIC GENERATOR.

PRICE 50 cents each; or the three Charts in ONE VOLUME, handsomely bound, 6 in. x 9 in., $1.00, postpaid.

FIREMAN'S CHART for Smoke Prevention; price $1.00, postpaid.

Stereopticon Slides showing above either in colors or plain.

RAND, McNALLY & CO.
Engineering Dept. Chicago, Ill.

Concrete Contract Work.

[Contributed]

CONCRETE SYSTEM.—By Frank B. Gilbreth, M. Am. Soc. M. E. New York: The Engineering News Publishing Co. Flexible morocco; 11 × 8 ins.; pp. 182; 11 plates and 220 text illustrations. $5, net.

This book is a very complete record of the experience of the author, and of the many able men who are and have been associated with him, in construction work involving concrete as its main material. It tells how concrete can best be handled in order to realize the ideals with which Mr. Gilbreth has conspicuously identified himself. He has from the first been an innovator, first in small matters in a local field, then in more important matters in a wider field, and lastly and now in the weightiest questions to which engineering construction gives rise, and in a field coextensive with such construction. A single aim seems to underlie all his activities, viz.: Honest work at the lowest cost; at high speed if required, but none the less honest work and the lowest cost for the speed.

It has seemed pertinent to mention these facts because the book under consideration is a record of the things which have been found successful—or better, perhaps, most successful—during a long career of unusual activity under the conditions and with the motive above alluded to, and no account of the book can be properly given or received except by those who keep in mind the author's career and its relations to the book.

The work may not inaptly be compared to a cook-book prefaced with the announcement: "Every recipe in this book has been personally tested by the author." The book was not written in the usual way or sense; it grew. And it was not published until experience had shown that it was practically full grown; that is, not until extensive works had been carried out under its rules without showing a necessity for addition, subtraction or change. It is not only the fruit of experience, but it is also the ripe fruit.

After this statement of its origin, it is perhaps superfluous to note that it differs in form and arrangement from the accepted model of a technical work. In this respect it may lead to clarity of understanding to again compare it to a cook-book. Instead of recipes there are propositions which the author calls Rules, numbered serially and grouped under fundamental topics into 13 chapters. The first chapter is devoted to general considerations, the second chapter to rules of general applications, and the remainder of the book to classes of work, as forms, reinforcement, mixing, etc.

A chapter on waterproofing cellars may be cited as a good example of the maturity of the work, since the writer personally knows that Mr. Gilbreth had the matter in this chapter developed and in use in his practice over eleven years ago in substantially the same form in which it now appears.

The work is copiously illustrated, mostly from photographs of works in progress under the author's contracts. Besides cuts of a page or less distributed through the text and cross-reference thereto, there is a second part of 71 pages, devoted exclusively to illustrations with explanatory titles. A table of contents and an index are provided.

The mechanical execution of the book is commendable. There may be more than one opinion as to the size and shape of page, 8 × 11 ins., bound to open at the end. The text is in three columns to the page, which gives a line-length convenient for reading and a compact placing of the run-in cuts of varying sizes. The paper and printing are excellent, and the binding a good one in flexible leather.

It may be well to enlarge a little upon the thought above advanced that this book of plain, almost commonplace and simple, practical rules represents the aims and aspirations of the author in the direction of honest work at lowest cost, since the relation may not be obvious to the casual reader of this notice, or even of the book itself; though it should seem that a careful reading of the book, and still more its use on engineering construction, must reveal its inward meaning.

Honest work means honest workers, not one only in a few, but all; honest in the sense of taking an interest in the work, and personally desiring that it shall be done well. Such an attitude is not one of muscle, but of mind or intelligence, and hence honest work in the truest sense demands that every one engaged upon it shall participate in it on the intellectual side and not merely on the physical.

The mere publication of these rules is a broad appeal to the intelligence of those to whom they are addressed. The author follows this up by incessant appeals in the rules themselves to the intelligence and sympathy of all classes of workers, from superintendent to common laborer. He takes the employee into his confidence to a large degree, by including in many of the rules the reasons on which they are based, or a statement of the advantages which will follow their observance, or of the bad results which will be produced by their violation or neglect. In this way he attempts to make each worker a thinking, interested participant with a sincere personal desire that the entire work shall be good. This surely makes for honest work.

Again, many of the rules and illustrations relate to the forms of organization and to details of administration which have been found best in practice to avoid duplication of work, waste of materials and labor, conflict of orders and other roughnesses which go to produce an excessive cost. Each worker is counseled not only as to how best to do his individual task, but is also constantly admonished that others are working with him, and that if his work is not regulated with due regard for all, there will be delay or other form of waste. The spirit of the book is highly developed "team work," and the book itself may be compared to a code of signals for a team. Coordination of effort makes for low cost as surely as individual interest does for honest work. Whatever opinion may be held as to the actual effect of the rules, it cannot be questioned that the foregoing is a fair statement of the effect which the author desires and intends them to have.

THEORY AND DESIGN OF REINFORCED CONCRETE ARCHES.—A Treatise for Engineers and Technical Students. By Arvid Reuterdahl, Chief of Bridge Department, Engineering Department, City of Spokane, Wash. Chicago and New York: The Myron C. Clark Publishing Co. Cloth; 6 × 9¼ ins.; pp. 126; 41 illustrations, mostly in the text, and 17 tables. $2, net.

Prof. William Cain's well-known little book on the reinforced-concrete arch did not pretend to do more than to apply the accepted theories of the elastic arch and the graphical treatment thereof to the somewhat peculiar conditions met in the then novel concrete arch reinforced with steel. And as he was merely restating old methods the author naturally omitted many of the intermediate steps that had been worked out for the simple case by previous investigators and contented himself with the plain statement of their present application. However, this method, while perfectly clear to those who were acquainted with the original studies on the elastic arch, left much to be desired from the beginner, to whom the intermediate steps were necessary. With the idea of filling these gaps and making a continuous and thorough exposition of the graphical treatment of the elastic reinforced-concrete arch, Mr. Reuterdahl has prepared the book noted above.

Mr. Reuterdahl has been an instructor in mathematics at Brown University and a Professor of Physics at Colby College, and his mathematical treatment of the subject shows the results of this professorial training. He says in the preface: "There are no missing steps in the necessary mathematical analysis of the theory." This is true with a vengeance. But that is rather a matter of praise than of blame, because the object of the book is to remove just those obscurities of previous books caused by a lack of consecutive mathematical processes. In this first place the author rightly acknowledges his indebtedness to Messrs. Cain and Eddy, from whom he has drawn largely and to whose work he has added little. The second part, the design of an actual arch, is somewhat more original, because it treats the bridge as an engineering work and not so much as a problem in graphics, the fault of many other authors.

For the student who wishes to master in one book the whole theory, to its minutest details, of the reinforced-concrete arch, and who is not over-awed by a succession of formulæ filled pages, we can commend the book. For any beginner in the designs of such bridges, the latter part will prove most useful.

THE MODERN ASPHALT PAVEMENT.—By Clifford Richardson, M. Am. Soc. C. E., Proprietor of the New York Testing Laboratory. Second Edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 6 × 9¼ ins.; pp. 629; 42 illustrations in the text. English price, 12s. 6d., net.

The first edition of this book was reviewed at length by Mr. Samuel Whinery in our issue of June 15, 1905. In the main, his opinions of the book were highly favorable.

The author states in his preface that he has revised the work completely and brought it up to date. He also states that he is indebted to Mr. C. N. Forrest for revision of the matter on analytical methods.

An examination of the present edition indicates that the revision has been carefully made, and that the book is bound to continue to occupy a high place in the literature of municipal engineering. It should, however, as suggested by Mr. Whinery, be remembered by those who read the book, that the author has long been and apparently still is connected with a particular branch of the asphalt paving industry.

A curious slip occurs on page 456, where the author states that the first cost of an asphalt pavement may be greater than "some *other* [italics ours] inferior forms of pavement," etc.

SEWERS AND DRAINS.—A Practical Treatise on the Selection, Design and Construction of Public and Domestic Sewerage and Drainage Systems, and Sewage-Disposal Plants for Cities, Towns and Other Municipalities, Including also Land Drainage and Cost Calculations. By Anson Marston, Dean of Division of Engineering and Professor of Civil Engineering, Iowa State College. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 156; plates and text illustrations. $1.

Considering the small space available to the author, and the object of the monographs issued by this correspondence school, Professor Marston's little treatise deserves favorable mention. The subject seems to be systematically covered. The most of the line drawings are well adapted to the text. Many of the half-tone plates, however, are quite as appropriate to any other monograph in the series as to this one, but we surmise that the author is not responsible for that. The work is a "separate" from the Cyclopedia of Civil Engineering issued by the same publishers.

JUST PUBLISHED

SPIRAL TABLES

PREPARED FOR THE
CANADIAN PACIFIC RAILROAD
By J. G. SULLIVAN

"If the inquiries hitherto received regarding this set of tables may be taken as an indication of the way they answer the requirements of railway engineers, this little book will prove to be the most popular transition-curve handbook, which would not be surprising, however, in view of the development of the tables during a period of 14 years to answer the requirements of one of the greatest railway systems on the continent."

50 Pages. 20 Tables.

PRICE, $1.50 NET Bound in Flexible Leather

PUBLISHED BY THE
McGRAW PUBLISHING CO.
239 WEST 39TH STREET. NEW YORK

Earth Slopes, Retaining Walls and Dams.

Reviewed by CHARLES L. CRANDALL.*

GRAPHIC DETERMINATION OF EARTH SLOPES, RETAINING WALLS AND DAMS.—By Charles Prelini, Professor of Civil Engineering, Manhattan College, New York City, Author of "Earth and Rock Excavation," etc. New York: D. Van Nostrand Co. Cloth; 6 × 9¼ ins.; pp. 129; 75 illustrations in the text. $2 net.

The author states that this book is intended for students and not for professional engineers, but the subject treated is one of deep interest to civil engineers as well.

The stability of earth slopes is considered, in the first chapter, on the basis of the angle of natural slope due to the internal friction of the material, and also by including with the friction the cohesion of the soil which is found to exist in old well settled banks. The subject is treated both graphically and analytically.

The slope of equal stability as affected by height of bank when cohesion is considered is then constructed, bringing out the steep top and flat bottom, which is characteristic of the natural earth slope. Comparisons are then made of the amounts of excavation per lin. ft. for a 50-ft. cut taken out to different uniform slopes, with those obtained for corresponding slopes of equal stability or equal safety and the saving in excavation shown.

The pressure of earth against retaining walls is taken up graphically in Chapter II., using the method given by Rebhann. The treatment includes the irregular profile or surcharge, also the effect of cohesion for walls supporting firm undisturbed earth free from water and frost. The passive pressure or the resistance of earth to motion from the horizontal thrust of say an arch is also considered.

The analytical method from Rebhann is developed in Chapter III., while the formulas of Rankine and Weyrauch are given without derivation. No account is taken of cohesion in this chapter. At the close of the chapter three tables are given showing the close numerical agreement between the three methods for heights of wall from 25 to 85 ft. for different batters and for different surcharges.

The design of retaining walls is considered in Chapter IV. The method is extended to walls with buttresses and counterforts, the latter both with and without relieving arches, but it is not extended to reinforced-concrete construction. Masonry dams are briefly discussed in the last chapter.

The stability of earth slopes and the earth pressure against retaining walls are well presented in the first three chapters. Attention is called to earth slopes as they actually occur and to the assumptions made by Rebhann in developing the methods used in finding the pressures against retaining walls.

The chapter on the design of retaining walls would have been of greater value to the student or to the young practicing engineer if it had been put more in touch with actual practice by considering the effects of character of soil, drainage, frost, and even of foundations upon stability, as was done for earth slopes, and by a few illustrations from practice. These applications would have been especially valuable in showing the application of theory to practice, an application which is questioned by many engineers.

An extension of the chapter to reinforced-concrete retaining walls in connection with the European system of buttresses, counterforts and relieving arches would have greatly enhanced the value of the book, even if added at the expense of the chapter on dams.

The treatment of masonry dams is brief, but a pretty good general idea is given of the methods of computing stability and of determining practical cross-sections with illustrations from European and American practice.

The typography is excellent, but the proof reading has been hastily done, as is evident by the discrepancies between cuts and text and by the corrections required in following the derivation of the formulas.

*Professor of Railroad Engineering and Geodesy, Cornell University, Ithaca, N. Y.

Five New "Power Handbooks."

ERECTING WORK.—Compiled and Written by Hubert E. Collins. New York and London: Hill Publishing Co. Cloth; 4½ × 7 ins.; pp. 140; 110 illustrations in the text. $1.

PIPES AND PIPING.—Compiled and Written by Hubert E. Collins. New York and London: Hill Publishing Co. Cloth; 4½ × 7 ins.; pp. 140; 75 illustrations in the text. $1.

KNOCKS AND KINKS.—Causes, Detection and Cure for Many of the Commonest of These Troubles of the Engine-Man. Plain Directions for Prevention and Remedy. Compiled and Written by Hubert E. Collins. New York and London: Hill Publishing Co. Cloth; 4½ × 7 ins.; pp. 137; 82 illustrations in the text. $1.

PUMPS.—Troubles and Remedies. Compiled and written by Hubert E. Collins. New York and London: Hill Publishing Co. Cloth; 4½ × 7 ins.; pp. 99; 35 illustrations in the text. $1.

SHAFT GOVERNORS.—Centrifugal and Inertia. Simple Methods for the Adjustment of All Classes of Shaft Governors. Compiled and written by Hubert E. Collins. New York and London: Hill Publishing Co. Cloth; 4½ × 7 ins.; pp. 127; 35 illustrations in the text. $1.

These books are compiled from material which has appeared in the columns of "Power," and deal with the work of the steam engineer and, more specifically, the engineman.

"Erecting Work" covers in a general way the successive operations involved in transferring from railway to power-house a heavy engine (1,200 HP.) and subsequently erecting it. It can scarcely be said to constitute a complete or connected treatise on this subject, but it contains much information on practical details which may save inexperienced engineers considerable annoyance. The first chapter discusses the building of engine foundations; the following nine chapters describe tackle and rigging suitable for unloading, transferring and erecting heavy engine parts. Throughout Chapters III. to X., the parts of a 1,200-HP. engine are taken as a specific case. In Chapter III., p. 30, the ratios of power to load for two luff tackle arrangements (Figs. 42 and 43) are incorrectly given as 1/28 and 1/35, the proper ratios being 1/29 and 1/34. Rope and sheave friction is not considered in comparing the various arrangements discussed. Chapter XI. deals with the erection of high-speed, center-crank engines. It is reproduced from an article contributed to "Power" by H. V. Hunt and C. G. Robbins and is much better written than the preceding chapters, in which a somewhat colloquial style and composition are pursued which, while very entertaining, do not tend toward brevity and clearness. Chapter XII. contains hints and suggestions on the heating and insertion of the links joining the segments of built-up fly-wheels and on the putting in place of pistons and crossheads.

"Pipes and Piping" is made up almost entirely of articles reprinted from "Power." No effort appears to have been made to reconcile or unify these articles, and the value of the book lies solely in the collection into one convenient volume of a mass of related material. There is room for considerable improvement in the index, which might have been made to add greatly to the value of the book. A chapter on high-pressure steam-pipe flanges includes sectional views of a number of different patterns and a table of dimensions and specifications transformed from a metric table adopted by the "Verein deutscher Ingenieure."

The third of these books, "Knocks and Kinks," is more satisfactory. It deals almost entirely with the causes of "knocking" in steam engines and with the means of locating and correcting them. With few exceptions the information is conveyed by describing actual cases and explaining the cause and cure of each. Chapter VIII. describes a method of "rigging up to turn and refit large pistons" and a crank-pin turning device. The final chapter describes the common method of finding the "dead center."

The first part of the fourth handbook, "Pumps," deals with the location and correction of pump troubles. Two short chapters give directions for setting the valves of duplex pumps, and Chapter XI. describes a means of indicating the instantaneous rate of delivery of a boiler feed pump at the time of observation. The final chapters contain tabulated information relating to pump performance and directions for pump operation of the sort commonly printed in catalogs of pumping machinery. The first half of the book gives many hints on practical points in pump operation as well as in repair work, and this is probably the most valuable feature of the book.

"Shaft Governors" contains an historical account of the development of this type of mechanism, with a classification of the forms in common use, followed by a series of separate chapters taking up the construction, operation and adjustment of a large number of specific makes of shaft governor, covering practically every type. The illustrations are line cuts of a diagrammatic character and ably supplement the text in making clear the operation of the various governor mechanisms. This book is, as a whole, better arranged and more unified than the others in this set, and should prove of value to anyone interested in its subject.

FIFTEENTH EDITION, REVISED
TOTAL ISSUE, THIRTY-FIVE THOUSAND

Kidder's Architects' and Builders' Pocket-Book

16mo, xix + 1703 pages, 1000 figures

Morocco, $5.00

Chapters on Fireproofing and Reinforced Concrete Rewritten by
RUDOLPH P. MILLER, C. E.

Section on Paint Rewritten by
ALVAH H. SABIN

JOHN WILEY & SONS
43 and 45 East 19th St. New York City

CALCULATE

By the new system of **"Products or Dividends."** Contained in a pocket book which is going to be as common as the dictionary. There are 4600 in use today and a special edition was just printed for the Western Pac. Ry. Co. The following is an extract from the text:

"This is a very simple book, but an extremely useful one, for it does away entirely with multiplication or division. One has but to learn its logical arrangement and to apply the most elementary arithmetic to become at once an adept computer. It takes a great deal of time to multiply and divide numbers, and it is tedious, hard mental work, too, but worse than anything else are the errors that are unavoidably made. There is always some doubt at best, and to be reasonably sure of correct work it takes double time and labor. Without the usual loss of time or labor this book gives absolutely correct results. There is no doubting or puzzling or laborious checking; results are infallible. When unusually large numbers are dealt with, it may require one or more additions or subtractions to carry results to many places of decimals, but even this simple matter is performed so methodically that the chance for error is practically eliminated."

Sent postpaid for $3.00

While its simplicity and practical usefulness make it worth far more than $3, yet it is ever a BOOK; hence the PRICE. 200 pages, Red Leather, BOND Paper, Gilt Edges. As a book, it is very artistic and durable; as a calculating implement, it is as positive and simple as a calendar. Your address will bring full particulars and endorsements. Address G. A. CHRISTENSEN, Civil Engineer, P. O. Box 22, San Francisco, Cal.

New Edition of Spalding's Roads and Pavements.

Reviewed by S. WHINERY,* M. Am. Soc. C. E.

A TEXT-BOOK ON ROADS AND PAVEMENTS.—By Frederick P. Spalding, M. Am. Soc. C. E., Professor of Civil Engineering, University of Missouri. Third edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 4¾ × 7½ ins.; pp. 340; 51 illustrations in the text. $2.

This is the third edition of Prof. Spalding's book, the first edition having appeared in 1894. New editions of engineering books offer opportunity to make corrections or additions and to bring the text up to the latest theory and practice. Prof. Spalding has evidently made good use of the opportunity.

While it is primarily intended as a text-book for classes in engineering schools, it will be found a convenient and satisfactory hand-book for non-professional general readers who wish to inform themselves on the elementary principles of designing and constructing roads and pavements.

In a review of some other books on the same subject, in Engineering News of Oct. 16, 1908, the present reviewer made some remarks about the responsibilities of writers of text-books, which seemed pertinent at the time. He is glad to say that Prof. Spalding's book meets fairly well the standard there outlined.

The book is as comprehensive as could be expected in one of its size dealing with so large a subject. The treatment is systematic and logical; the style is terse and the statements of facts are generally accurate and free from ambiguity. The critical reader will, however, note a few exceptions to the last statement. On page 58 the author says:

> The length of a road and the amount of rise and fall on it determine the amount of work that must be done in hauling a load over the road. The rate of gradient, on the contrary, does not affect the amount of work necessary to move the traffic, but it limits the work that a horse may do at one trip.

Which is both ambiguous and inaccurate.

The statement on page 173 that natural cement is usually employed for concrete foundations for pavements was true a few years since, but applies now to certain sections of the country only.

The arrangement of subjects and chapters does not differ materially from the other leading books on roads and pavements and need not be dwelt upon here. Those who have kept fairly well posted on the subject will not find, nor could they expect, much that is new, either in matter or treatment, in a book intended primarily as an elementary text-book for students; but within the appropriate scope of a college text-book, the author has accomplished all that could reasonably be demanded.

On the whole, it may be said without reservation that the book is the best elementary text-book on Roads and Pavements yet produced.

Electrical Engineering for Boys.

HOW TO UNDERSTAND ELECTRICAL WORK.—A Simple Explanation of Electric Light, Heat, Power and Traction in Daily Life. By William H. Onken, Jr., Associate Editor "The Electrical World," and Joseph B. Baker, Technical Editor, U. S. Geological Survey. With a Dictionary of Electrical Terms Prepared by Joseph H. Adams. New York and London: Harper & Brothers. Cloth; 5½ × 8 ins.; pp. 359; numerous illustrations in the text. $1.75.

Most American boys, it seems safe to wager, can distinguish electrical machinery from mere mechanical devices, and indeed can even tell something of the probable use of the apparatus, if it be something they are apt to run across in ordinary life. The authors of this book have tried to deepen such knowledge by explaining electrical phenomena and actions and quantities in simple words and by familiar analogies. But for a boy to see what they mean when they talk about Ohm's Law, about "current varying directly as the electromotive force and inversely as the resistance," it would seem he must be about ready to leave his high school and with some understanding of algebra.

The authors tell how dynamos are driven and how transformers and other machinery are built—inside. All the various electric lamps are described. Electric furnaces and the many products made possible by their development have a prominent place. The use of electricity for railroad transportation, in our common industries, on the farm, in the home, in the mine, as the doctor's assistant, everywhere, are taken up with the idea of showing how the applications are made. Finally there is a dictionary of terms to help the boy through the most technical parts.

It is a deep book for a boy—one that will make him ask a mass of questions of his possibly overtaxed parent, but one that will stimulate his mind if he be mechanically inclined.

DIFFERENTIAL AND INTEGRAL CALCULUS.—By Daniel A. Murray, Ph. D., Professor of Applied Mathematics in McGill University. London, Bombay and New York: Longmans, Green & Co. Cloth; 5¼ × 8¼ ins.; pp. 491; numerous figures in the text. $2, net.

Engineers who have lost touch with calculus methods, by not having frequent need for applying them, can make profitable use of this text-book. Its style is of the best. The order of development which the author employs is somewhat different from that found in most other text-books of calculus, and this in itself gives it value as a guide in the review of the subject. The scope is fully equal to that of other college texts, although the author specifically says that it contains "little more than what may be regarded as the essentials of a primary course." Differential and integral calculus are treated separately, the former coming first, and this separation is the chief difference between this work and the same author's "First Course in Infinitesimal Calculus," after which in fact the present work was modeled.

CEMENT LABORATORY MANUAL.—A Manual of Instructions for the Use of Students in Cement Laboratory Practice. By L. A. Waterbury, Professor of Civil Engineering, University of Arizona. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 4¾ × 7½ ins.; pp. 122; 28 illustrations in the text. $1; English price, 4s. 6d., net.

As pointed out in the sub-title, this book is more particularly designed for the instruction of students in the methods of procedure in the cement laboratory and it applies to actual cement testing only so far as such preliminary study takes up the problems of commercial testing. The details of equipment are so well treated that as a guide for establishing and administration of an instructing laboratory, the manual should prove most useful and the outlines of experiments are so prescribed that it should be equally valuable as a textbook.

INTERCORPORATE RELATIONSHIPS OF RAILWAYS IN THE UNITED STATES.—Pub. Doc. Washington, D. C. Interstate Commerce Commission. Cloth; 6 × 9 ins.; pp. 516; illustrated.

This special report by the Division of Statistics and Account, Interstate Commerce Commission, presents the results of an investigation as to the extent to which (and in what manner) the securities of one railway company are held by another company. A few diagrams illustrate the intricate complications of these intercorporate relationships. For the summary for railways aggregating 216,804 miles of line it appears that the total outstanding funded debt amounts to $9,342,961,476, and the total stock outstanding amounts to $8,884,234,925. The railways themselves hold about 15% of the former and 46% of the latter. These percentages, however, do not include the amounts held by corporations and individuals so closely identified with railway corporations that these securities cannot properly be considered as being in the hands of the public. As a matter of fact, therefore, the percentages held and controlled by the railways are considerably larger than those which are directly held by them.

LIGHTING COUNTRY HOMES BY PRIVATE ELECTRIC PLANTS.—By T. H. Amrine. Bulletin No. 25, University of Illinois Engineering Experiment Station. Urbana, Ill.: The University. Paper; 6 × 9 ins.; pp. 35; 11 illustrations in the text.

The author of this bulletin has planned the design of small, isolated, electric, house-lighting plants from a non-technical point of view and with special reference to the needs of farmers. Low-voltage tungsten lamps, Holophane globes, a storage battery and a gasolene engine are important factors in the typical 17-lamp installation outlined. The author has emphasized the necessity of decreasing the brilliancy of the lamps by shading and frosting. [illegible] house illumination is first planned and the storage and generating outfit is designed to fit that scheme. The cost of the typical [illegible] outlined is given from $470 upward depending on the taste or fancy of the owner.

MACHINE SHOP CALCULATIONS.—By [illegible] H. Colvin, M. Am. Soc. M. E., Associate [illegible] of "The American Machinist," Author of [illegible] Machine Shop Arithmetic," etc. New York and London: [illegible] Hill Publishing Co. Cloth; 4½ × 7 ins.; pp. [illegible] text illustrations. $1.

In most machine shops employing [illegible] or more workmen, a considerable proportion [illegible] be found who have never had as much as [illegible] ordinary grammar school education. Ocassionally such a man's ambition may be aroused sufficiently to cause him to wish to remedy the deficiencies in his education and to acquire a working knowledge of enough of arithmetic, geometry and trigonometry to enable him to solve the problems met with in the machinists trade. "Machine Shop Calculations" is evidently intended for just such men. The opening chapters on arithmetical processes are thoroughly elementary. In the succeeding chapters are taken up the selection of gears for thread cutting, set-over of tailstock for tapers, speed of pulleys and many other problems of a like nature. The explanations are so simple and thorough that any machinist able to read at all should easily understand them. The last chapter alone, on "Uses of Shop 'Trig.'" and possibly Chapter XVII., on "Making and Using Formulas," would be of value to machine shop foremen or superintendents who, while possessing a fair general education, have no knowledge of those subjects.

RAILROAD CONSTRUCTION.—Theory and Practice. A Text-Book for the Use of Students in Colleges and Technical Schools. By Walter Loring Webb, M. Am. Soc. C. E. Fourth edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Morocco; 4 × 7 ins.; pp. 777; 10 plates and 217 text illustrations. $5; English price, 21s., net.

In our issue of April 16, 1903, we reviewed the second edition of this book. Although that edition was considerably different from the first, the changes which have been made since then are only of a minor nature, so the review of the earlier date still applies to the present edition. Such changes as have been made in the last two editions are mostly in the arrangement and contents of the tables, although in the fourth edition the chapter on Economics has been brought down to present unit costs and the earthworks section has been revised for the better, especially insofar as the cost data are concerned. The book is still the best condensed study of railroad construction available for students and beginners.

RAILROAD ENGINEERING.—An Authoritative Manual of Modern Practice in the Survey, Location and Construction of Railroad Lines and Terminals, Their Operation and Maintenance, and the Financing and Economic Management of Railroad Corporations. By Walter Loring Webb, Consulting Civil Engineer, Author of "Railroad Construction," etc. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 296; folding and other plates, and numerous text illustrations. $3.

As this book takes up in the space of 288 widely spaced pages the whole subject of railroad engineering, including surveys, construction, operation, maintenance and economics of management, it is obvious that it must be but a cursory treatment. Indeed, its only value

TRAUTWINE'S
CIVIL ENGINEERS'
POCKET BOOK

18th Edition, 90th Thousand, 1907, $5.00

JOHN WILEY & SONS
SCIENTIFIC PUBLISHERS
43 and 45 East 19th Street, New York City

*Consulting Engineer, 95 Liberty St., New York City.

seems to be for preliminary reading to give a survey of the whole field of railroad work to the beginner, who afterward may study more detailed works for the actual principles. The author's is drawn largely, almost entirely in fact, both phrase and thought, from his previously published works.

The volume is one of the papers which have been published together under the general title, "Cyclopedia of Civil Engineering," and which was reviewed in our issue of Nov. 12, 1908.

Statistics of Water Transportation.

TRANSPORTATION BY WATER.—1906. Special Report. Bureau of the Census; S. N. D. North, Director. Washington, D. C.: Pub. Doc. Cloth; 9 × 12 ins.; pp. 224; diagrams, tables and four plates.

This report is of special interest and value at a time when so much public attention is being paid to waterway improvement. The volume contains a vast amount of statistical matter, and is an invaluable reference book for any engineer who has to make a study of water transportation. The first part of the book is devoted to the country as a whole; the second section to the Atlantic Coast and the Gulf of Mexico; the third to the Pacific Coast; the fourth to the Great Lakes and St. Lawrence River; the fifth to the Mississippi River and its tributaries, and the sixth to canals and other inland waters. The total mileage of canals and canalized rivers in the United States in 1906 was 3,644 miles. This includes not only the waterways controlled by the Federal Government, but those owned by States, like the canals of New York, and a few canals still in the control of private companies. Of this total mileage a little over 2,000 miles are canals proper, and the remainder is slack-water navigation. The total cost of construction and improvement of these waterways is given as $283,000,000, which would amount to an average cost per mile of $80,000 in round numbers. Of course, this average is drawn between works that have a vast range of cost. For example, the short canal, 1.6 miles long, at Sault Ste. Marie has cost $8,000,000, while the slack-water navigation of the Little Kanawha, in West Virginia, 48 miles long, cost only $500,000. The total appropriations by Congress for harbors and waterways to the present time are $553,000,000, in round numbers, of which over $301,000,000 have been appropriated since 1890. A still better evidence of the rapid increase in appropriations for waterway improvement is the fact that the average expenditure for fifteen years from 1890 was about $20,000,000 per annum, while the River and Harbor bill of 1907 carried $37,500,000.

The volume contains most elaborate statistics of traffic on the various waterways, which should be of much service to the fair investigator who desires to test the soundness of current arguments for waterway improvement.

THE TEMPERATURE-ENTROPY DIAGRAM.—By Charles W. Berry, Assistant Professor of Mechanical Engineering in the Massachusetts Institute of Technology. Section edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 4¾ × 7½ ins.; pp. 209; 109 figures in the text. $2, net; English pricce, 8s. 6d., net.

The first edition of this book was reviewed by the late Prof. Storm Bull in Engineering News, May 18, 1905, with a very favorable criticism. In the second edition now appearing considerable additions have been made. In fact, the number of pages has been doubled. The general ground covered by the additions are best shown by quoting from the author's preface to the second edition.

In the revised edition of the Temperature-Entropy Diagram a more extended application of the principles of the Tφ-analysis to advanced problems of thermo-dynamics has been made than was possible in the limited scope of the previous edition. The chapter on the flow of fluids has been entirely rewritten and treats at length various irreversible processes. A graphical method of projecting from the su- into the Tφ-piane has been elaborated for perfect gases and its application illustrated in the chapters on hot-air engines and gas-engines. The various factors affecting the cylinder efficiency of both gas-and steam-engines have been thoroughly discussed. One chapter has been devoted to the thermodynamics of mixtures of gases and vapors, and another to the description and use of Mollier's total energy-entropy diagram.

The former edition had 12 chapters and this has 17. In addition to the former chapters of general discussions on reversible cycles and irreversible processes, on the temperature-entropy diagram for perfect gases, saturated and superheated vapors, flow of fluids, of applications to hot-air, gas, steam and multiple-fluid engines, etc., the author has added chapters on (1) Mollier's total energy-entropy diagram, (2) thermodynamics of mixtures of gases, of gases and vapors, and of vapors, (3) the gas-engine indicator card, and (4) steam-engine cylinder efficiency. The chapter on compressions and refrigeration has been expanded into two.

THE DESIGN AND EQUIPMENT OF SMALL CHEMICAL LABORATORIES.—By Richard K. Meade, Editor of "The Chemical Engineer," Author of "Portland Cement," etc. Chicago, Ill.: The Chemical Engineer Publishing Co. Cloth; 6 × 9¼ ins.; pp. 186; 111 illustrations in the text. $2, net.

The author of this little book says:

It very often happens that the young chemist, perhaps fresh from college, is called upon to design and equip a laboratory when his knowledge of how it is to be done is rather meager.

The author has made it his object to provide the information that is needed for success in such a predicament. The first chapter takes up the general arrangement and location of the laboratory and its apparatus. Next come several chapters on stationary equipment. The balance of the book describes and discusses the smaller apparatus and miscellaneous equipment. The book is well supplied with illustrations, and the explanations are made in a clear and direct manner. In connection with each subject discussed, practical details are introduced which will make the book of great value to those called upon to superintend the construction and installation of laboratory equipment.

HEATING AND VENTILATION.—A Working Manual of Approved Practice in the Heating and Ventilating of Dwelling-Houses and Other Buildings, with Complete Practical Instruction in the Mechanical Details, Operation and Care of Modern Heating and Ventilating Plants. By Charles L. Hubbard, Consulting Engineer on Heating, Ventilating, Lighting and Power. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 221; plates, and 177 text illustrations. $1.50.

This book opens with a brief general presentation of the subject of heating and ventilating. It outlines the general systems of warming buildings, the principles of ventilation and discusses the various losses of heat from structures being heated and ventilated.

The details of the several methods of warming are recorded. In each case the "furnace" or apparatus for extracting the heat from the burning fuel is described and the construction and proper operation of the intermediate apparatus, by which heat is distributed about the building, are laid down. In the part more particularly devoted to ventilation, the exhaust and plenum systems of obtaining warmed fresh air are described and compared. Fans, blowers, air filters, washers, etc., are all taken up in turn. There are also sections on temperature regulations and on electric heaters.

The subject matter seems to have been presented with the idea of allowing or leading the careful reader to designing heating and ventilating systems. Sample computations and problems are inserted at different points.

It should, perhaps, be added that the volume is a section, separately presented, of the "Cyclopedia of Civil Engineering," noticed in our issue of Nov. 12, 1908.

SURVEYOR'S HAND BOOK.—By T. U. Taylor, M. Am. Soc. C. E., Professor of Civil Engineering in the University of Texas. Chicago and New York: The Myron C. Clark Publishing Co. Flexible leather; 4½ × 6¾ ins.; pp. 310; 116 illustrations in the text. $2, net.

We have noted many times before that there is no field for another book on surveying unless it possesses some transcendent qualities, the exact nature of which are not apparent, since the present works on the subject seem amply to answer the purpose for which they were designed. After reading this latest book we see no reason to change our expression of opinion. The material and the method of presentation have nothing of novelty and the typography is wretched; in fact, the tables at the end of the book are quite illegible in places. It may be that we were unfortunate in the copy sent to this office, but the general appearance of the book belies this supposition.

TABLES FOR CALCULATING SIZES OF STEAM PIPES FOR LOW PRESSURE HEATING.—By Isaac Chaimovitsch. Chicago, Ill.: Domestic Engineering. Cloth; 4½ × 7 ins.; pp. 47; nine illustrations in the text. $2.

These tables and the accompanying text are stated to have been prepared for those who have not had enough experience to judge of the limitations of mere "rules of thumb" in the design of steam pipes. These tables are calculated to show the loss of pressure per linear foot of pipe, in diameters of ¾ to 24 ins., for various deliveries of steam under 1, 3 and 5 lbs. boiler pressure. The use of the tables is explained and illustrated.

ISTHMIAN CANAL COMMISSION.—Annual Report for the Fiscal Year Ended June 30, 1908. (Lieut.-Col. Geo. W. Goethals, U. S. Army, Chairman and Chief Engineer.) Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 358; 194 plates.

The general report of the Commission occupies a small part of this large volume (see Eng. News, Dec. 3, 1908, for considerable portions of the general report). Many appendices and a large number of folding plates swell the volume to a thickness of some two or three inches. The appendices, generally speaking, deal at length with matters touched upon more briefly in the general report. Appendix E, by Mr. C. M. Saville, Assistant Engineer, recounts at considerable length investigations made to facilitate the safe design of the Gatun Dam. These studies include analyses of materials available for hydraulic-fill construction, seepage tests of soils and materials from bore holes, and a description of and observations on experimental hydraulic-fill dams similar to the one proposed at Gatun. Many related subjects pertaining to the percolation of water through dams are taken up by Mr. Saville.

MASSACHUSETTS STATE BOARD OF HEALTH.—39th Annual Report. (X. H. Goodnough, Chief Engineer.) Boston, Mass.: Pub. Doc. (No. 34). Cloth; 5½ × 9 ins.; pp. 616; one folding diagram.

As usual, the matters in this annual report of greatest interest to engineers relate to the Lawrence experiments on water purification and the treatment of sewage. These investigations, in general, have followed the line of recent years. Other portions of the report detail special chemical and bacterial investigations of the effect of cold storage upon drawn and undrawn poultry, give the results of dairy inspection throughout the state, set forth a special study of infant mortality in Boston made between June 1 and Nov. 30, 1907, and also give the results of the study of the growth of pathogenic bacteria in milk. A new feature of this report is "a record of the proceedings and observations of the state inspectors of health." There are 15 of these inspectors, appointed by the State Board of Health in accordance with authority granted by recent legislation.

SABIN'S
CEMENT AND
CONCRETE

Second Edition, Revised and Enlarged

584 Pages, 161 Tables Price, $5.00 Net

"Among the features of this book which deserve special attention, are the chapters upon the testing of cement, and the chapter upon the methods and cost of concrete making, both of which subjects are treated more completely and carefully than in any other work with which we are familiar."

Send for descriptive circular

McGRAW PUBLISHING CO.
239 W. 39th St., NEW YORK

Publications Received.

BULLETINS, U. S. GEOLOGICAL SURVEY.—George Otis Smith, Director. Washington, D. C.: Pub. Doc. Paper; 5⅜ × 9¼ ins.

No. 362: Mine Sampling and Chemical Analyses of Coals Tested at the United States Fuel-Testing Plant, Norfolk, Va., in 1907. By John Shober Burrows. Pp. 23.

No. 369: The Prevention of Mine Explosions. Report and Recommendations. By Victor Watteyne, Inspector-General of Mines, Belgium; Carl Meissner, Councillor for Mines, Germany; and Arthur Desborough, H. M. Inspector of Explosives, England. With Letter of Transmittal by James Rudolph Garfield, Secretary of the Interior. Pp. 11.

CHRONOMETRIE.—By J. Andrade. Part of "Encyclopédie Scientifique," published under the direction of Dr. Toulouse. Paris, France: Octave Doin. Cloth; 4½ × 7¼ ins.; pp. 382; 193 illustrations in the text. 5 francs; American price, $1.50.

CITY OF MANCHESTER, RIVERS DEPARTMENT.—Annual Report for the Year Ending March 25, 1908. (John Frowde, Chairman.) Manchester, England: Pub. Doc. Paper; 6 × 9¾ ins.; pp. 22; folding and other tables, and four folding diagrams.

COAL.—Bulletin 9, Fourth Series, Geological Survey of Ohio; J. A. Bownocker, State Geologist. Part I.: Coals of the Monongahela Formation or Upper Productive Coal Measures. Part II.: Chemical Analyses and Calorific Tests of the Clarion, Lower Kittanning, Middle Kittanning and Upper Freeport Coals. Geology by J. A. Bownocker. Chemistry by N. W. Lord and E. E. Somermeier. Columbus, O.: Pub. Doc. Cloth; 6¼ × 9¾ ins.; pp. xii. + 342; seven plates, and two maps in pocket.

COMMISSIONER OF EDUCATION.—Report of the Year Ended June 30, 1907. Vol. I. (Elmer Ellsworth Brown, Ph.D., LL.D., Commissioner.) Washington, D. C.: Pub. Doc. Cloth; 5¾ × 9¼ ins.; pp. 522; diagrams and tables.

CONCRETE.—Its Uses in Building, from Foundations to Finish. By Thomas Potter. Third edition, revised and enlarged. London, England: B. T. Batsford. New York: D. Van Nostrand Co. Cloth; 5½ × 8¾ ins.; pp. 328; 138 illustrations, mostly in the text. $3, net.

CONCRETE BLOCKS.—Their Use in Residences. (Reprinted from "Concrete.") Detroit, Mich.: Concrete Publishing Co. Paper; 6 × 9 ins.; pp. 32; illustrated. 25 cts.

THE DESIGN OF HIGHWAY BRIDGES.—And the Calculation of Stresses in Bridge Trusses. By Milo S. Ketchum, M. Am. Soc. C. E., Dean of College of Engineering and Professor of Civil Engineering, University of Colorado. New York: The Engineering News Publishing Co. London, England: Archibald Constable & Co., Ltd. Cloth; 6 × 9 ins.; pp. 544; 309 illustrations, partly in the text, and 77 tables. $4, net.

DESTRUCTION OF CONCRETE BY ALKALI.—By William P. Headden. Bulletin 132, The Agricultural Experiment Station of the Colorado Agricultural College. Fort Collins, Colo.: The Experiment Station. Paper; 6 × 9¼ ins.; pp. 8.

ELECTRIC MOTORS.—Their Installation, Control, Operation and Maintenance. By Norman G. Meade. New York: McGraw Publishing Co. Cloth; 4¾ × 7½ ins.; pp. 159; 126 illustrations in the text. $1, net.

ELECTRIC RAILWAY AUDITING AND ACCOUNTING.—By William H. Forse, Jr., Vice-President American Street and Interurban Railway Accountants Association, Treasurer Indiana Union Traction Co. New York: McGraw Publishing Co. Cloth; 6 × 9½ ins.; pp. 157; 48 illustrations in the text. $2, net.

ELECTRICAL ILLUMINATING ENGINEERING.—By William Edward Barrows, Jr., Assoc. M. Am. Inst. E. E., Assistant Professor of Electrical Engineering, Armour Institute of Technology. New York: McGraw Publishing Co. Cloth; 5¼ × 8¾ ins.; pp. 216; 135 illustrations in the text. $2, net.

ELECTRIFICATION OF THE ST. CLAIR TUNNEL.—By F. A. Sager. Montreal, Canada: The Grand Trunk Ry. (General Passenger Department). Paper; 7 × 10 ins.; pp. 36; illustrated.

FOWLER'S MECHANICAL ENGINEER'S POCKET BOOK, 1909.—Edited by William H. Fowler, M. Inst. C. E., M. Inst. M. E., etc. 11th Annual Edition. Manchester, England: Scientific Publishing Co. Leather; 3¾ × 6 ins.; pp. 639; text illustrations. 2s. 6d.; American price, $1. In cloth, 1s. 6d.; American price, 60 cts.

GEOLOGIC ATLAS OF THE UNITED STATES.—U. S. Geological Survey, George Otis Smith, Director. No. 161: Franklin Furnace Folio—New Jersey. Washington, D. C.: Pub. Doc. Stiff paper; 18½ × 22½ ins.; pp. 27; 6 plates and 15 text illustrations.

HANDBUCH DES MATERIALPRUEFUNGSWESENS FUER MASCHINEN- UND BAUINGENIEURE.—By Otto Wawrziniok, Adjunct at the Royal Technical College, Dresden. Berlin, Germany: Julius Springer. Cloth; 6 × 9¼ ins.; pp. 573; 501 illustrations, mostly in the text. 20 marks; American price, $8.

HYDRAULIC ENGINEERING.—A Practical Treatise on the Principles of Water Pressure and Flow and Their Application to the Development of Water Power, Including the Calculation, Design and Construction of Water Wheels, Turbines, and Other Details of Hydraulic Power Plants. Part I.: Hydraulics. By Frederick S. Turneaure, Dean, College of Engineering, University of Wisconsin. Part II.: Water-Power Development. By Adolph Black, Adjunct Professor of Civil Engineering, Columbia University, New York. Chicago, Ill.: American School of Correspondence. Cloth; 6¼ × 9¾ ins.; pp. 267; plates, and 200 text illustrations. $3.

ILLINOIS HIGHWAY COMMISSION.—Annual Report for the Year 1907. (Edmund J. James, Chairman, Urbana, Ill.) Springfield, Ill.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 90; 16 plates, 21 text illustrations, and 4 folding tables.

ILLINOIS STATE GEOLOGICAL SURVEY.—H. Foster Bain, Director. Bulletin No. 8: Year-Book for 1907. Urbana, Ill.: Pub. Doc. Cloth; 5½ × 8¾ ins.; pp. 391; 23 plates, 32 text illustrations, and 1 map in pocket.

AN INVESTIGATION OF THE SANITARY CONDITION OF THE GOWANUS CANAL, BROOKLYN, N. Y.—Charles F. Breitzke, Inspecting Engineer, State Department of Health, Albany, N. Y. Contribution from the Sanitary Research Laboratory and Sewage Experiment Station of the Massachusetts Institute of Technology. (Reprinted from the Technology Quarterly, Vol. XXI., No. 3, September, 1908.) Paper; 7 × 10¼ ins.; pp. 243 to 279; 14 illustrations in the text.

LECTURE-NOTES ON THE THEORY OF ELECTRICAL MEASUREMENTS.—Prepared for the Third-Year Classes of the Cooper Union Night-School of Science. By William A. Anthony, Late Professor of Physics, Cooper Union. Third edition, revised by Albert Ball, Assistant Professor of Physics and Applied Electricity, Cooper Union. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 4¾ × 7½ ins.; pp. 122; text illustrations. $1; English price, 4s. 6d., net.

THE LUMBER CUT OF THE UNITED STATES, 1907.—Compiled in Cooperation with the Department of Agriculture: Forest Service, Gifford Pinchot, Forester. Forest Products, No. 2, Bureau of the Census; S. N. D. North, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 53.

THE MECHANICAL ENGINEERING OF STEAM POWER PLANTS.—By Frederic Remsen Hutton, Professor Emeritus of Mechanical Engineering in Columbia University, Past President and Honorary Secretary of the American Society of Mechanical Engineers. Third edition, rewritten. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ × 9¼ ins.; pp. 825; 697 illustrations, mostly in the text. $5; English price, 21s., net.

THE "MECHANICAL WORLD" POCKET DIARY AND YEAR BOOK FOR 1909.—Containing a Collection of Useful Engineering Notes, Rules, Tables and Data. Manchester, England: Emmott & Co., Ltd. Cloth; 4 × 6¼ ins.; pp. 395; text illustrations and tables. 6d., net; American price, 20 cts., net.

MICHIGAN STATE BOARD OF HEALTH.—Annual Report of the Secretary for the Fiscal Year Ending June 30, 1907. (Frank W. Shumway, Secy.) Lansing, Mich.: Pub. Doc. Cloth; 6¼ × 9¼ ins.; pp. 188.

THE MINNESOTA ENGINEER.—Published Quarterly by The Engineers' Society, University of Minnesota. A Continuation of the Year Book. Vol. XVII., No. 1, November, 1908. Minneapolis, Minn.: University of Minnesota. Paper; 6¾ × 10¼ ins.; pp. 65; text illustrations, and one folding plate.

THE MUNICIPAL ENGINEERS OF THE CITY OF NEW YORK.—Proceedings for 1907. Edited by the Publication and Library Committee, George A. Taber, Chairman. New York: The Municipal Engineers (29 West 39th St.). Cloth; 5¾ × 9¼ ins.; pp. 234; folding and other plates.

THE NATIONAL ASSOCIATION OF COTTON MANUFACTURERS.—Transactions, Annual Meeting Held in Huntington Hall, Massachusetts Institute of Technology, Boston, Mass., April 16-17, 1908. (C. J. H. Woodbury, Secy.) Boston, Mass.: The Association (45 Milk St.). Boards, 6 x 9¾ ins.; pp. 532; illustrated.

OHIO ELECTRIC LIGHT ASSOCIATION.—Proceedings 14th Annual Convention, Put-In-Bay, L. E., Ohio, Aug. 25-27, 1908. (D. L. Gaskill, Secy., Greenville, O.) Cloth; 6 × 9 ins.; pp. 172; illustrated.

PRELIMINARY REPORT ON THE MINERAL RESOURCES OF OKLAHOMA.—Bulletin No. 1. Oklahoma Geological Survey; Charles N. Gould, Director. By Charles N. Gould, L. L. Hutchison and Gaylord Nelson. Norman, Okla.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 84; 10 illustrations in the text.

THE PRINCIPLES OF ALTERNATING CURRENTS.—For Students of Electrical Engineering. By Edgar T. Larner, Assoc. Inst. E. E., of the Engineering Department, G. P. O., London. New York: D Van Nostrand Co. London, England: Crosby Lockwood & Son. Cloth; 4¾ × 7½ ins.; pp. 136; 72 figures in the text. $1.50, net.

PRINCIPLES OF SEWAGE TREATMENT.—By Professor Dr. Dunbar, Director of the Hamburg State Hygienic Institute. Translated, with the author's sanction, by H. T. Calvert, Ph.D., Chief Chemical Assistant, West Riding of Yorkshire Rivers Board. London, England: Charles Griffin & Co., Ltd. Philadelphia, Pa.: J. B. Lippincott Co. Cloth; 6¼ × 9 ins.; pp. 271; 147 illustrations, mostly in the text. $4.50, net.

THE PRODUCTION OF PETROLEUM IN 1907.—By David T. Day. Advance Chapter from Mineral Resources of the United States, Calendar Year 1907. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 133; one illustration in the text.

RECEIPTS AND EXPENDITURES OF ORDINARY REVENUE (Boston).—With Appendix Showing All Classes of Receipts and Expenditures, by Groups, 1903-1907. Special Publications, No. Department, City of Boston. Boston Doc. Paper; 9¼ × 11½ ins.; pp. 16

REPORT ON THE RESULTS OF AN I OF THE CONDITIONS CAUSING TH OF THE MOSHASSUCK, WOONA AND PROVIDENCE RIVERS.—In the Island. Made Conjointly by the U. Survey and the Rhode Island State Bo by Mr. Herman Stabler, Assistant E Geological Survey. Providence, R. I. of Health. Paper; 6 × 9¼ ins.; pp. 77

RESERVOIRS FOR IRRIGATION, W AND DOMESTIC WATER-SUPPLY.— count of Various Types of Dams and Plans and Cost of Their Construction. Schuyler, M. Am. Soc. C. E., M. Ins Second edition, revised and enlarged. John Wiley & Sons. London, England: Hall, Ltd. Cloth; 6½ × 10¼ ins.; pp. 5 trations, mostly in the text, and 6 foldi

SMOLEY'S TABLES.—Parallel Tables of Lo Squares, Angles and Logarithmic Fun sponding to Given Bevels, Together with Set of Five-Decimal Logarithmic-Trigo bles. For Engineers, Architects and S Constantine Smoley. Fifth edition, r York: The Engineering News Publishin don, England: Archibald Constable & Flexible morocco; 4¾ × 7 ins.; pp. 448.

STANDARD SPECIFICATIONS FOR CAST TER PIPE AND SPECIAL CASTINGS.—W of Dimensions, Thicknesses and Weights May 21, 1908, by American Water Works Paper; 6 × 9 ins.; pp. 33; illustrated. Association].

STATE RIVERS AND WATER SUPPLY COMMISSION. (Victoria, Australia).—Third Annual Repor (M. Nally, Secy., Treasury Gardens, Melbourne, Melbourne, Victoria: Pub. Doc. Paper, ins.; pp. 32; illustrations in the text.

DIE STATIK DES KRANBAUES.—By W. Ludwig Andrée. Munich and Berlin: R. Oldenbourg. Cloth; 6½ × 9½ ins.; pp. 220; 380 illustrations in the text. 8 marks; American price, $3.20.

STEAM-BOILERS.—By Cecil H. Peabody, Professor of Naval Architecture and Marine Engineering, and Edward F. Miller, Professor of Steam Engineering, Massachusetts Institute of Technology. Second edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ × 9¼ ins.; pp. 434; 5 plates and 176 text illustrations. $4; English price, 17s., net.

A TEXT-BOOK OF MECHANICAL DRAWING AND ELEMENTARY MACHINE DESIGN.—By John S. Reid, M. Am. Soc. M. E., Professor of Mechanical Drawing and Designing, Armour Institute, and David Reid, Formerly Instructor in Mechanical Drawing and Designing, Sibley College, Cornell University, Ithaca, N. Y. Second edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ × 9¼ ins.; pp. 439; 329 illustrations in the text. $3; English price, 12s. 6d., net.

DIE THEORIE DER BESSELSCHEN FUNKTIONEN.—By Paul Schafheitlin. Leipzig and Berlin. B. G. Teubner. Stiff paper; 5 × 8 ins.; pp. 129; one folding plate. 2.80 marks; American price, $1.15.

TRAIN DISPATCHERS' ASSOCIATION OF AMERICA.—21st Annual Convention, Fort Worth, Tex., June 16, 1908. (J. F. Mackie, Secy., C., R. I. & P. Ry., Chicago, Ill.) Paper; 5¼ × 7¾ ins.; pp. 175; illustrated.

VALVE SETTING.—Simple Methods of Setting the Plain Slide Valve, Meyer Cut-Off, Corliss and Poppet Types. Compiled and written by Hubert E. Collins. New York and London: Hill Publishing Co. Cloth; 6 × 9½ ins.; pp. 209; 200 illustrations in the text. $2.

DER WASSERBAU.—Für Studierende und Praktiker. By M. Strukel, Professor at the Finland Technical College in Helsingfors. Part II.: Water-Supply, Sewerage, Drainage, Irrigation, and Canals for Navigation. Second edition, revised and enlarged. Leipzig, Germany: A. Twietmeyer. Paper; 7½ × 10½ ins.; pp. 239; 23 plates and 29 illustrations in the text. 16 reichsmarks.

WATER-SUPPLY PAPERS, U. S. GEOLOGICAL SURVEY.—George Otis Smith, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.

No. 222: Preliminary Report on the Ground Waters of San Joaquin Valley, California. By Walter C. Mendenhall. Pp. 62; one folding plate.

WATER POWER OF HALIFAX, NOVA SCOTIA.—Part I., Dartmouth Lakes Power. By F. W. W. Doane, City Engineer, Halifax. (From Proceedings and

JUST PUBLISHED

WATER POWER ENGINEERING

By DANIEL W. MEAD,
Professor of Hydraulic and Sanitary Engineering, University of Wisconsin.

Chapter I.—Introduction. The History of Water Power Development. II.—Power. III.—Hydraulics. IV.—Water Power. Study of the Power of a Stream as Affected by Flow. V.—Water Power (continued). Study of the Power of a Stream as Affected by Head. VI.—Rainfall. VII.—The Disposal of the Rainfall. VIII.—Run-off. IX.—Run-off (continued). X.—Stream Flow. XI.—The Measurement of Stream Flow. XII.—Water Wheels. XIII.—Turbine Details and Appurtenances. XIV.—Hydraulics of the Turbine. XV.—Turbine Testing. XVI.—Selection of the Turbine. XVII.—Load Curve and Load Factor, and Their Influence on the Design of the Power Plant. XVIII.—Speed Regulation of Turbine Water Wheels. XIX.—The Water Wheel Governor. XX.—Arrangement of the Reaction Wheel. XXI.—Selection of Machinery and Design of Plant. XXII.—Examples of Water Power Plants. XXIII.—The Relation of Dam and Power Station. XXIV.—Principles of Construction of Dams. XXV.—Appendages to Dams. XXVI.—Pondage and Storage. XXVII.—Cost Value and Sale of Power. XXVIII.—The Investigation of Water Power Projects.

803 Pages. 413 Illustrations. Net, $6.00.

Send for 8-page Circular.

McGRAW PUBLISHING CO., 239 W. 39th St., NEW YORK

Trans[illegible]ons of the Nova Scotian Institute of Science. [illegible]. XII., Part 1.) Paper; 5½ × 8¾ ins.; pp. 21 [illegible]

WESTE[illegible] RAILWAY CLUB.—Official Proceedings for the [illegible] Year 1907-1908. Chicago, Ill.: The Club (J. [illegible] Taylor, Secy., 390 Old Colony Building). Clo[illegible] × 9 ins.; pp. 361; folding plates and text illu[illegible]ons.

WIRE[illegible] TELEGRAPHY AND TELEPHONY.—Popularly explained. By Walter W. Massie and Charles R. [illegible]rhill. With Special Article by Nikola Tesla. New [illegible]rk: D. Van Nostrand Co. Cloth; 4¾ × 7½ ins., 76; 29 illustrations, mostly in the text; $1, net.

FOURTH THOUSAND NOW READY

TURNEAURE and MAURER

Principles of Reinforced Concrete Construction

8vo, viii + 317 pages, 11 plates and 130 figures. Cloth, $3.00.

JOHN WILEY & SONS

43 and 45 East 19th St., New York City

Eighth Thousand Now Ready

Taylor and Thompson's

Treatise on Concrete

Plain and Reinforced

8vo, Cloth, $5.00

JOHN WILEY & SONS

43 and 45 East 19th St., New York City

Kent's Mechanical Engineers' Pocket Book

16mo, morocco, $5.00

TOTAL ISSUE, 60,000

JOHN WILEY & SONS

Scientific Publishers

43 and 45 East 19th St., New York City

New Books of Special Interest to Engineers

By Thomas Conyngton, of the New York Bar

Corporate Organization

Enlarged Edition. Discusses in detail the formation of a corporation from selection of name and capitalization to complete organization; indicating the danger points and giving numerous and most valuable suggestions. Contains forms for subscription lists, charters, by-laws, option agreements, voting trust agreements, etc., etc. The most practical work of its kind. 400 pages, 6 × 9 inches, 1908. Buckram binding. Prepaid, $3.00.

Corporate Management

Third Edition. A practical work on the management of corporations, telling what to do and how and when. Treats of by-laws, stock, stockholders, directors, officers, regular and special meetings, minutes, corporate records, etc., etc. Contains over 200 forms used in corporate procedure. More largely used in the United States than any other similar work. 400 pages, 6 × 9 inches, 1909. Buckram. Prepaid, $3.00.

Send for circulars and list of business books.

THE RONALD PRESS COMPANY

Rooms, 90-92, 229 Broadway, New York

About Our New Engineering and Contracting Books

The Latest book from the press on the subject of reinforced concrete is one that Mr. E. Lee Heidenreich has been engaged in writing for the past eight years. Mr. Heidenreich, in fact, was the first American to produce a book on reinforced concrete, namely his "Monier Constructions" which was published in 1900. Immediately after that he entered upon the task of preparing his "Engineers' Pocket Book of Reinforced Concrete," which has at length been completed. Speaking of books of this sort, he has said in his preface, "It is almost impossible to find the proper moment when the book may be considered temporarily finished." Whatever misgivings the author may have as to the delay in finishing his pocketbook, the reader can have none, for the development of general knowledge of concrete and the accumulation of tests, etc., have been so rapid and so extensive in the past eight years, that it may be safely said that a pocketbook of this sort published at a much earlier date than the present would have been premature. The author is a member of the "Joint Committee for Concrete and Reinforced Concrete" appointed by the American Society of Testing Materials, and the American Society of Civil Engineers.

In its 374 pages there are 7 chapters whose titles are as follows:

(1) Materials and Machines Used in Concrete Construction.
(2) Design and Construction of Buildings.
(3) Design and Construction of Bridges.
(4) Abutments and Retaining Walls.
(5) Culverts, Conduits, Sewers, Pipes and Dams.
(6) Tanks, Reservoirs, Bins and Grain Elevators.
(7) Chimneys. Miscellaneous Data.

There are 80 tables in Heidenreich's "Pocketbook" which are alone of inestimable value as savers of time in designing reinforced concrete structures. The tables for proportioning columns, slabs, beams, etc., are very complete.

Formulas for designing the various kinds of reinforced-concrete structures are deduced and discussed, and their application illustrated by examples, thus making Heidenreich's "Pocketbook" exceptionally useful to the designing engineer who wants a compact mass of information on the subject in hand.

Heidenreich's Engineers' Pocket Book of Reinforced concrete is bound in flexible leather, 4½ × 6¾ ins., 374 pages, 164 illustrations, and its price is 3.00, net, postpaid.

In January we expect to have Albert I. Frye's "Pocketbook for Civil Engineers" off the press. Its 1,200 pages of "5½ and 6 pt. solid type" are equivalent to 4,000 pages of the ordinary 6 × 9-in. book set in "10 pt. lead" or Long Primer. This simple statement will give some idea of the magnitude of the task of writing the book, to say nothing of the additional task of putting it into type and of proof-reading. In reading the proof, Frye's Pocketbook will pass through the hands of four proofreaders and it is believed that it will be as free from errors as human skill, care and patience can make it. The original calculations for tables, examples, etc., have been checked with the greatest care; and, wherever similar tables have existed, Frye's tables have been checked against them. There are more new and extensive tables in this pocketbook than any single author has ever produced before. We have mentioned elsewhere one illustration to indicate the amount of mental work that has been involved in producing certain tables, but it will bear repeating. On one hydraulic table, which occupies only 3 pages printed, the author put in 12 weeks of constant labor in calculation and checking. In that case he had to apply a complex formula in each separate calculation, and the work was unusually tedious; but we mention this instance that the reader may realize that the "scissors and paste pot" has not played an important part in the production of this pocketbook. As above stated, we plan to have Frye's "Pocketbook" off the press in January. We are receiving a great number of advance orders now at $5.00, net, postpaid. This book, like all the other Clark books, can be bought nowhere at less than the net price, for the high cost of publication and the closer margin of profits have made it impracticable to give discounts on any high class books, unless they are books that are passing rapidly out of date. In this connection, we may add, the average purchaser of a technical book seldom appreciates the cost of keeping a technical book up to date by frequent revisions and entire reprinting. A novel remains unchanged forever, and, once the plates are made, it can be produced at a low cost, not only because of the large number printed, but because of the permanence of the plates. An engineering book, on the other hand, begins to go out of date before it is off the press, so that both author and publisher are compelled to begin a revision almost before they have seen the first bound copy—provided they hope to keep the book abreast of the times. It is our intention to revise Frye's "Pocketbook" at short intervals, and to notify all purchasers direct as to each revision, wherever we have the address of the purchaser. Hence the advantage of ordering all our books direct from us, instead of through local dealers. Bear in mind, also, that we have two offices, one in New York, the other in Chicago.

The Sale of Gillette's "Handbook of Cost Data" continues to break all records for an engineering or technical book. Those engineers or contractors who have not examined a copy of the book will get a pretty clear idea of its contents by sending for our 24-page pamphlet of Gillette's "Handbook," containing sample pages and a full table of contents. For estimating costs and for effecting a reduction in existing costs, this 622-page book is worth many fold its $4.00 price, net, postpaid.

Four Other Books on concrete merit consideration. Of these four, one is only two months' old, namely, Reuterdahl's "Theory and Design of Reinforced Concrete Arches." Mr. Reuterdahl is Chief of the Bridge Department of Spokane, Washington. In his work as a designer of concrete bridges, he felt the need—as, indeed, has every other designer—of a complete printed analysis of the elastic arch. The author says: "Of all the problems in bridge designing, the analysis of the elastic arch is by far the most difficult. The works which have heretofore appeared on this subject are either so mathematically abstruse, or leave so much to the reader to demonstrate for himself, that they are of little value to the practical engineer or to the technical student whose mathematical training has not been of exceptional order. The entire absence in technical literature of a work obviating these unfortunate features has been brought so forcibly to the attention of the author that he has felt justified in undertaking the present work.

"It was felt that the graphical method of analysis would be preferred by both engineer and technical students to the longer and more involved mathematical method of analysis.

Every principle involved in the graphical treatment is explained thoroughly and in detail in the theoretical portion of the work. There are no missing steps in the necessary mathematical analysis of the theory as set forth in the present treatise."

Reuterdahl's "Concrete Arches" contains numerous diagrams and tables and 132 pages, 6 × 9 ins. Its price is $2.00, net, postpaid.

McCullough's "Reinforced Concrete" is also one of our most recent publications. It is not a large book, only 136 pages, but it contains much original matter drawn from the extensive experience of the author in designing and erecting reinforced concrete buildings, and other concrete structures. It is richly worth the $1.50 that it costs.

Reid's "Concrete and Reinforced-Concrete Construction" is a veritable encyclopedia on the subject, containing a thousand pages. It is the most expensively illustrated technical book of which we have any knowledge. Its 700 illustrations—mostly line drawings from working plans—would, even without any accompanying text, be sufficient to make the book one that would be constantly referred to. Reid's "Concrete and Reinforced-Concrete Construction" is the standard 6 × 9 size, and its price is $5.00, net, postpaid.

The fourth book on concrete differs from all others, in that it deals solely with methods and costs. We refer to Gillette & Hill's "Concrete Construction, Methods and Cost." In its 700 pages, concrete and reinforced concrete are considered from the view point of the engineering and contracting economist. Considered merely as a book to be used in estimating costs of all kinds of cement structures, the book is of great value; but it is of greater value in so designing or building concrete structure as to reduce their cost. The book is barely more than six months old, but it has a phenomenal sale, which indicates that it fills a real gap in concrete literature and not an imaginary one.

Circulars will gladly be sent describing any of our books, giving sample pages, tables of contents, etc. We advertise none but books of our own publication.

The following are some of our important books:

20 NEW AND STANDARD BOOKS.

FRYE.—Pocketbook for Civil Engineers (ready in January). Leather; 1,200 pages.....$5.00
FALK.—Cements, Mortars and Concretes—Their Physical Properties. Cloth; 6 × 9 ins.; 184 pages $2.50
GILLETTE.—Handbook of Cost Data. Leather; illustrated; 622 pages.....$4.00
GILLETTE.—Rock Excavation, Methods and Cost. Cloth; illustrated; 5½ × 7 ins.; 384 pages..$3.00
GILLETTE & HILL.—Concrete Construction, Methods and Cost. Cloth; 6 × 9 ins.; 700 pages; 310 illustrations $5.00
GILLETTE & DANA.—Cost Keeping and Construction Economics (ready in February).....
GILBRETH.—Field System. Leather; illustrated; 200 pages $3.00
GILBRETH.—Bricklaying System. (Ready Jan. 1.) Cloth; 6 × 9 ins.; 275 pages.....$3.00
INSKIP.—Tables of Five Place Logarithms and Five Place Squares, from 0 to 100 Feet by Thirty-seconds of an Inch, with Tables of Logarithmic Secants, Natural and Logarithmic Functions, etc. Flexible leather; 6 × 7½ ins.; 280 pages....$3.00
KINDELAN.—Trackman's Helper. Cloth; 334 pages; illustrated $1.50
LOVELL.—Practical Switch Work. Cloth; 174 pages; illustrated $1.00
LAVIS.—Railroad Location Surveys and Estimates. Cloth; 6 × 9 ins.; 270 pages; 73 illustrations; 10 folding plates $3.00
McCULLOUGH.—Engineering Work in Towns and Cities. Cloth; illustrated; 430 pages.....$3.00
McCULLOUGH.—Reinforced Concrete, A Manual of Practice. Cloth; illustrated; 136 pages.....$1.50
MAYER.—Telephone Construction, Methods and Cost. Cloth; 6 × 9 ins.; 300 pages; 100 illustrations; 157 tables.....$3.00
REID.—Concrete and Reinforced-Concrete Construction. Cloth; 6 × 9 ins.; 906 pages; 715 illustrations; 70 tables $5.00
REUTERDAHL.—Theory and Design of Reinforced-Concrete Arches. Cloth; 6 × 9 ins.; 140 pages; illustrated $2.00
SMITH.—Maintenance of Way Standards on American Railways. Cloth; 567 pages; 100 plates.$1.50
TAYLOR. T. U.—Surveyors' Handbook. Leather; 328 pages; illustrated $2.00
TAYLOR W. PURVES.—Practical Cement Testing; 6 × 9 ins.; 330 pages; 142 illustrations; 58 tables $3.00

The Myron C. Clark Publishing Co.,

357 Dearborn Street, CHICAGO

New and Recent Publications

8vo, cloth, 757 pages, 310 illustrations. Price, **$5.00 net.**

Hydraulics and Its Applications

By A. H. GIBSON, M. Sc., Assoc. M. I. C. E.

4⅜ in. x 6½ in., cloth, 290 pages, 113 illustrations. Price, **$2.50 net.**

Manual of

Reinforced Concrete and Concrete Block Construction

By CHAS. F. MARSH & WM. DUNN

8vo, cloth, 136 pages, 75 illustrations. Price, **$2.00 net.**

Graphical Determination of Earth Slopes, Retaining Walls and Dams

By CHARLES PRELINI, Professor of Civil Engineering, Manhattan College, New York City

2¾ in. thick, cloth, 517 8 x 11 in. pages. **$10.00 net.**

41 Tables, 560 Illustrations, 63 Plates

Cranes

Their Construction, Mechanical Equipment and Working

By ANTON BOTTCHER

Translated and Supplemented with **American**, English and Continental Practice

By A. TOLHAUSEN, C. E.

12mo, cloth, 68 pages, 15 illustrations. **$2.00 net.**

Water Hammer In Hydraulic Pipe Lines

With a chapter on the

Speed Regulation of Hydraulic Turbines

By A. H. GIBSON, M. Sc., Assoc. M. I. C. E.

8vo, cloth, 400 pages, 236 illustrations. **$6.00 net.**

The Practical Design of Irrigation Works

Setting forth the principle governing the design, in a detailed as well as a general aspect.

By B. BLIGH

8vo, cloth, 301 pages, illustrated. **$5.00 net.**

Irrigation

Its principles and practice as a branch of engineering. By Sir HANBURY BROWN, K. C. M. G., Member of the Institution of Civil Engineers (late Royal Engineers).

D. VAN NOSTRAND CO.

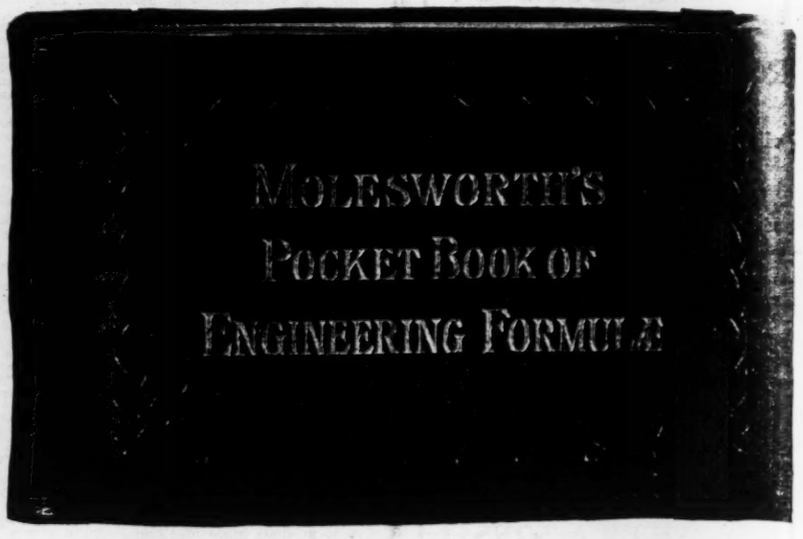
Publishers and Booksellers

23 Murray and 27 Warren Streets, N. Y.

A Book for the Pocket

The 26th Edition of MOLESWORTH'S POCKET BOOK OF ENGINEERING FORMULAE is now ready, and orders will be filled promptly.

There has been a most careful and complete revision of this useful Pocket Book since the last edition was published and CIVIL, MECHANICAL and ELECTRICAL ENGINEERS will find it, as heretofore, *the best and only real Pocket Book.* **Price, $2.00 net.**



Exact Size of Pocketbook

By Sir GUILFORD L. MOLESWORTH, K.C.I.E.

Past President of the Institution of Civil Engineers
Member of the Institution of Mechanical Engineers Fellow of the University of Calcutta

Assisted by

HENRY BRIDGES MOLESWORTH, M. Inst. C. E.

WITH AN ELECTRICAL SUPPLEMENT

By WALTER H. MOLESWORTH, M. Inst. E. E., M. Inst. M. E.

SPECIAL OFFER FOR DECEMBER.—Upon receipt of $2.00 for a copy, we will stamp your name in gold on front cover, free of charge, and mail book to you postpaid.

SPON & CHAMBERLAIN

123 E.N. Liberty Street NEW YORK

Types and Details of

BRIDGE CONSTRUCTION

By FRANK W. SKINNER, M. Am. Soc. C. E.

Vol. I. Arch Spans.

CONTENTS.—PART I.—Wood and Iron Arch Spans. II.—Spandrel Braced Arches. III.—Arch Trusses. IV.—Plate Girder Arches.

301 Pages. 300 Illustrations. Price, $3.00 Net.

Vol. II. Plate Girders.

CONTENTS.—PART I.—General Features of Design and Construction and Service. II.—Examples of Railroad Plate Girder Spans. III.—Details of Bearings and Splices. IV.—Multiple Railroad Spans on Steel Towers. V.—Highway and Special Spans. VI.—Discussion of Plate Girders by Eminent Designers as follows: H. S. Jacoby, J. A. L. Waddell, H. W. Hodge, J. V. W. Reynders, John Sterling Deans, J. B. French.

424 Pages. 300 Illustrations. Price, $4.00 Net.

Vol. III. Specifications and Standards for Short Railroad Spans.

CONTENTS.—PART I.—Specifications, Consideration of 35 Leading Specifications. II.—Illustrations and Descriptions of Standard Designs and Details. III.—Floors for Short Spans. IV.—Discussion of Standard Designs by the following: J. B. French, Bridge Engineer, Long Island Railroad; Mason B. Strong, recently Engineer of Bridges, Erie Railroad; J. E. Greiner, Engineer of Bridges and Buildings, Baltimore & Ohio Railroad.

300 Pages. 142 Illustrations. 32 Tables. Price, $3.00 Net.

PUBLISHED AND FOR SALE BY

McGRAW PUBLISHING CO., 239 West 39th Street, N. Y.

BOOKS FOR ENGINEERS

Analysis of Elastic Arches, by J. M. Balet
Cloth; 6×9 ins.; 320 pages; 184 diagrams; 6 Folding Plates, 19 Tables $3.00

Earth Dams, by Burr Bassell
Cloth; 6 × 9 ins.; 68 pages; 31 illustrations $1.00

Field Practice of Railway Surveying, by Willard Beahan
Cloth; 6 × 9 ins.; 260 + x pages; 43 illustrations, 7 Folding Plates $3.00

Reinforced Concrete, by Buel and Hill
Cloth; 6 × 9 ins.; 499 pages; Tables, Diagrams and 340 illustrations. $5.00

Economics of Railway Operation, by M. L. Byers
Buckram; 6 × 9 ins.; 672 pages; many illustrations, diagrams and forms showing standard and most recent practice. $5.00

Dictionary of Mechanical Drawing, by Geo. H. Follows
Cloth; oblong, 8 1-4 × 10 3-4 ins.; 60 pages; 45 illustrations. $1.00

Earthwork and its Cost, by H. P. Gillette
Cloth; 5 × 7 1-2 ins.; 256 pages $2.00

Economics of Road Construction, by H. P. Gillette
Cloth; 6 × 9 ins.; 48 pages; 9 illustrations $1.00

Earthwork Tables, by R. S. Henderson
Heavy paper; oblong, 8 1-2 × 11 3-4 ins.; 32 pages $1.00

Engineering Contracts and Specifications, by J. B. Johnson
Cloth; 6 × 9 ins.; 566 pages $3.00

City Roads and Pavements, by W. P. Judson
Cloth; 6 × 9 ins.; 197 pages, 69 illustrations $2.00

Road Preservation and Dust Prevention, by W. P. Judson
Cloth; 6 × 9 ins.; 144 pages; 16 illustrations $1.50

Design of Steel Mill Buildings, by M. S. Ketchum
Cloth; 6 × 9 ins.; 464 + xiv pages; 189 Figs.; Specifications, Problems, 15 Tables $4.00

Design of Walls, Bins and Grain Elevators, by M. S. Ketchum
Cloth; 6 × 9 ins.; 394 + xiv pages; 260 Figs.; 40 Tables; 2 Folding Plates $4.00

Design of Steel Highway Bridges, by M. S. Ketchum
Cloth; 6 × 9 ins.; 550 + xiv pages; 300 Figs.; 77 Tables; 8 Folding Plates $4.00

Concrete System, by Frank B. Gilbreth
Flex. Morocco; 8 1-2 × 11 ins.; 200 pages; 220 illustrations and 10 Folding Plates; Printed on finest coated paper.. $5.00

Hydrographic Surveying, by S. H. Lea
Cloth; 6 × 9 ins.; 200 pages $2.00

Surveying Manual, by Pence and Ketchum
Flex. Leather; 4 1-2 × 6 1-2 ins.; 252 pages $2.00

Technic of Mechanical Drawing, by C. W. Reinhardt
Cloth; oblong, 8 × 11 ins.; 42 pages; 90 illustrations, 11 full page plates $1.00

Tables of Logarithms and Squares, by C. Smoley
Flex. Morocco; 5 × 7 ins.; 472 + x pages..... $3.50

Modern Tunnel Practice, by D. McN. Stauffer
Buckram; 6 1-4 × 9 1-2 ins.; 314 pages; 138 illustrations.. $3.50

Railway Transition Spiral, by A. N. Talbot
Flex Leather; 4 × 6 3-4 ins.; 102 + vi pages $1.50

Bridge and Structural Design, by W. C. Thomson
Cloth; 6 × 9 ins.; 83 pages; 76 illustrations $2.00

Design of Typical Railway Bridges, by W. C. Thomson
Cloth; 6 × 9 ins.; 178 + vii pages; 21 Diagrams and Detail Drawings (including 5 Folding Plates) $2.00

Railway Track and Trackwork, by E. E. R. Tratman
Cloth; 6 × 9 ins.; 520 pages; 232 illustrations; 44 Tables and an Appendix of Statistics of Standard Track Construction on American Railways. Third Edition, Revised and Enlarged $3.50

Specifications and Contracts, by Waddell and Wait
Cloth; 6 × 9 ins.; 174 pages; Marginal Index $1.00

Batter Tables, by C. G. Wrentmore
Buckram; 8 × 10 ins.; 192 pages $5.00

Manual of Civil Service Examinations, by Lewis and Kempner
In 3 Volumes and 8 Parts and Complete in one Volume, with appendixes, Complete Volume $5.00

Sewage Disposal Works, by H. P. Raikes
Cloth; 6 × 9 ins.; 414 + xv pages; 72 illustrations..... 4.00

Descriptive circulars of the above and other technical books on request

THE ENGINEERING NEWS BOOK DEPARTMENT

220 Broadway **New York**

JOHN WILEY & SONS

New Publications

RICHARDS—Laboratory Notes on Industrial Water Analysis.

A Survey Course for Engineers. 8vo, iii + 49 pages. Cloth, 50 cents net.

SCHUYLER—Reservoirs.

For Irrigation, Water-power, and Domestic Water Supply. Second Edition, Revised and Enlarged. Large 8vo, xxvi + 573 pages, 381 figures, 6 plates. Cloth, $6.00.

BERRY—The Temperature-Entropy Diagram.

Second Edition, Revised and Enlarged. 12mo, xviii + 299 pages, 109 figures. Cloth, $2.00.

RICHARDSON—The Modern Asphalt Pavement.

Second Edition, Revised and Enlarged. 8vo, ix + 629 pages, 42 figures. Cloth, $3.00.

OBERG—Handbook of Small Tools.

Comprising Threading Tools, Taps, Dies, Cutters, Drills and Reamers, Together with a Complete Treatise on Screw-thread Systems. Large 12mo, ix + 517 pages, 282 figures. Cloth, $3.00.

MOYER—The Steam Turbine.

A Practical and Theoretical Treatise for Engineers and Designers. Including a Discussion of the Gas Turbine. 8vo, ix + 370 pages, 225 figures. Cloth, $4.00.

BRENNAN'S HANDBOOK.

A Compendium of Useful Legal Information for Business Men. 16mo, 571 pages. Morocco, $5.00 net.

PEABODY-MILLER—Steam Boilers.

Second Edition, Revised and Enlarged. 8vo, viii + 434 pages, 176 figures, 5 folding plates. Cloth, $4.00.

PREFACE TO SECOND EDITION.—A considerable amount of new material and many new illustrations have been added in the Second Edition.

While but few changes have been made in the treatment of the subject, each chapter has been added to and revised.

A short chapter on Superheaters has been added; also a number of tables giving the dimensions of and the floor space occupied by the different types of boilers and by economizers.

The subject of steam-piping has been treated at greater length.

C. H. P. and E. F. M.

CONTENTS.—Types of Boilers. Superheaters. Fuels and Combustion. Corrosion and Incrustation. Settings, Furnaces and Chimneys. Power of Boilers. Staying and Other Details. Strength of Boilers. Boiler Accessories. Shop Practice. Testing Boilers. Boiler Design. Appendix. Index.

OGDEN—Sewer Construction.

8vo, xii + 335 pages, 192 figures. Cloth, $3.00.

BURR-FALK—The Design and Construction of Metallic Bridges.

Second Edition. 8vo, xiii + 532 pages, many figures in the text and 4 folding plates. Cloth, $5.00.

COMSTOCK—A Text Book of Field Astronomy for Engineers.

Second Edition, Revised and Enlarged. 8vo, xii + 218 pages. Cloth, $2.50.

RUST—Ex-Meridian Altitude, Azimuth and Star Finding Tables.

8vo, ii + 395 pages, 13 figures, including 6 folding diagrams. Cloth, $5.00.

PUTNAM—Nautical Charts.

8vo, viii + 162 pages, 48 figures. Cloth, $2.00.

RICHARDS—The Cost of Cleanness.

12mo, v + 109 pages. Cloth, $1.00.

ELLIOTT—Practical Farm Drainage.

Second Edition, Rewritten. 12mo, ix + 188 pages, 46 figures. Cloth, $1.50.

JOHNSON—Statics by Algebraic and Graphic Methods.

Second Edition, Revised and Enlarged. 8vo, xi + 169 pages, 70 figures, 13 double-page plates. Cloth, $2.00.

SPALDING—A Text Book on Roads and Pavements.

Third Edition, Revised and Enlarged. 12mo, x + 340 pages, 51 figures. Cloth, $2.00.

WEBB—Railroad Construction.

Fourth Edition, Revised and Enlarged. 16mo, xvii + 777 pages, 217 figures, 10 plates. Morocco, $5.00.

WATERBURY—Cement Laboratory Manual.

12mo, vii + 122 pages, 28 figures. Cloth, $1.00.

GEBHARDT—Steam Power Plant Engineering.

8vo, xxix + 816 pages, 461 figures. Cloth, $6.00 net.

HUTTON—The Mechanical Engineering of Steam Power Plants.

Third Edition, Rewritten. 8vo, xii + 825 pages, about 700 figures. Cloth, $5.00.

WILSON—Elements of Railroad Track and Construction.

12mo, v + 320 pages, 181 figures. Cloth, $2.00.

MORRISON—Highway Engineering.

8vo, v + 315 pages, 60 figures. Cloth, $2.50.

BREED-HOSMER—The Principles and Practice of Surveying.

Volume II. Higher Surveying. 8vo, xvii + 432 pages, 162 figures. Cloth, $2.50.

TURNEAURE-RUSSELL—Public Water Supplies.

Second Edition, Revised and Enlarged. 8vo, xv + 808 pages, 229 figures. Cloth, $5.00.

43 and 45 East 19th Street New York City

CONSTRUCTION NEWS

Supplement to ENGINEERING NEWS. New York, December 17, 1908.

CONTENTS.

CONSTRUCTION NEWS:
Plans and Specifications on File.....213
List of Contracts Pending.....213
Railroads.....213
Electric Railways.....213
Lighting and Power Plants.....214
Bridges.....214
Buildings.....215
Water Supply and Irrigation.....216
Sewerage.....217
Garbage Disposal.....217
Streets and Roads.....217
Manufacturing Plants.....218
Miscellaneous Contracts.....218
Contract Prices.....219
U. S. Possessions and Cuba.....220
CIVIL SERVICE EXAMINATIONS.....220
PROPOSALS.....220

CONSTRUCTION NEWS.

PLANS AND SPECIFICATIONS ON FILE.

(denotes that this work is advertised in Engineering News.)*

The following plans (P.) and Specifications (S.) are on file and may be seen at the office of The Engineering News Publishing Co., 220 Broadway, New York.

Bids close.	Work.	Place.	See Issue.
12-22	Bridge,	Cazenovia, N. Y.	(S.)12-10
12-24*	Seawall,	Fort Morgan, Ala.	(P. & S.)12- 3
1- 6	Garbage crematory,	Fort Slocum, N. Y.	(P. & S.)12-10
1- 9	Galleries, Wash., D. C. (Buildings)		(S.)12-17

LIST OF CONTRACTS PENDING.

LIGHT, HEAT AND POWER PLANTS.

12-17 Electric work, New York.....12-10
12-17 Switchboard, Washington, D. C..12-17
12-18 Engines, etc., Warren, Pa.....12-17
12-22 Light system, Jefferson Barracks, Mo.....12- 3
12-23 Power plant, New York.....12-17
12-28* Power plant, etc., Winnipeg, Man.12- 3
12-28 Electric equipment, New York..12-17
12-29 Light and power, New York.....12-17
1- 4 Lighting, Hartford, Conn.....11-12
1- 4* Engines, generators, etc., Ft. Monroe, Va.....12-10
1- 5 Light fixtures, Frankfort, Ky.....12-17

BRIDGES.

12-18 Bridge, Cincinnati, Ohio.....12- 3
12-19 Bridges, etc., Batesville, Ark.....12-10
12-21 Bridge, Morrisville, Pa.....12- 3
12-22* Bridge, etc., Fort Hunter, N. Y..12-10
12-22 Bridge, Cazenovia, N. Y.....12-10
12-24 Bridge, Sumner, Wash.....11-26
1- 1 Rebuilding bridge, Newport, Ore.12-10
1- 1* Bridge, Handsboro, Miss.....12-17
1- 4 Bridge work, Sandusky, Ohio.....12-17
1- 5 Bridges, Stockton, Cal.....12-17
1- 5 Bridge, Grenada, Miss.....12-17
1- 5 Bridge, Fairport, N. Y.....12-17
1- 8 Bridges, etc., Cincinnati, Ohio....12-17
1-11 Bridge repairs, Minneapolis, Minn.....12-17
1-11 Bridges, Newark, Ohio.....12-17
1-12 Bridges, Geneva, Neb.....12-17
1-12* Bridge, Augusta, Ga.....12-17
1-12 Bridge, Rensselaer, Ind.....10-29
3- 4 Bridges, Paris, Ark.....12-17

BUILDINGS.

12-17 Post-office, Medicine Hat, Alta...12-10
12-17 School, Stamford, Conn.....12-10
12-17 Museum, New York.....12-10
12-17 Infirmary, New York.....12-10
12-18 Steel, Madison, Wis.....11-19
12-19 School, Passaic, N. J.....11-26
12-19 Court-house, St. Anthony, Idaho..11-26
12-20 Plans, East Liverpool, Ohio.....11-26
12-21* Buildings, Cheyenne, Wyo.....12- 3
12-21 Schools, New York.....12-10
12-21 Ice machine, etc., Burrwood, La. (Mfg. Pl.) 12- 3
12-21* Hydrotherapeutic equipment, Hot Springs, S. Dak.....11-26
12-21 Exhib. bldgs., Seattle, Wash.....11-19
12-21* Fire protection, Washington, D. C.....12-17
12-21 Fittings, Calgary, Alta.....12-17
12-22 Pathological equip., New York...12-17
12-22 Buildings, Mt. Weather, Va.....12-17
12-22 Post-office, Coldwater, Mich.....11-19
12-23 School, Jersey City, N. J.....11-26
12-23* Hospital, Buffalo, N. Y.....12-10
12-23* Post-office, Alexandria, Minn...11-19
12-23 Jail, Montreal, Que.....12-17
12-26* Post-office, Americus, Ga.....11-19
12-26 School, San Jose, Cal.....12-10
12-28 Post-office, Lake Charles, La....11-19
12-28 Schools, New York.....12-17
12-29 Post-office, Alton, Ill.....11-26
12-29 School, Philadelphia, Pa.....12-10
12-29 Building, Columbus, Ohio.....12-10
12-30 Building, Vernon, B. C.....12-10
12-31 Quarters, Ft. Howard, Md.....12-17
1- 2 Church, St. Paul, Minn.....12-17
1- 2 Court-house, Boston, Mass.....12-17
1- 2 Church, Evansville, Ind.....12- 3
1- 2 Church, Elkhart, Ind.....12- 3
1- 4 Post-office, Sault Ste. Marie, Mich.11-26
1- 5* Post-office, Niles, Mich.....11-26
1- 6 Post-office, Paris, Ill.....12-10
1- 6 Quarters, etc., Ft. Slocum, N. Y..12-10
1- 7 Post-office, Johnson City, Tenn...12-10
1- 8 Dormitory, Stillwater, Okla.....12-17
1- 9* Post-office, Murfreesboro, Tenn..12-10
1- 9 Galleries, Wash., D. C.....12-17
1-11 Post-office, Gainesville, Fla.....12-10
1-12* Post-office, Warren, Ohio.....12-17
1-14 Plans, Milwaukee, Wis.....12- 3
1-15 Asylum, St. Louis, Mo.....12-10
1-18* Hay-shed, Ft. Meade, S. Dak.....12-17
2-10* Quarters, New London, Conn....12- 3

WATER-WORKS.

12-17 Water pipe, etc., New York.....12-10
12-17 Pumping machinery, Orange, N.J.12-10
12-19 Reservoir, dam, etc., Arroyo-hondo, N. Mex.....12-17
12-19 Wells, Fort McKinley, Me. 12-17
12-21* Water system, Wash., D. C.....12-17
12-21 Water mains, New York.....12-17
12-21 Water pipe, Astoria, Ore.....12- 3
12-23 Main, Buffalo, N. Y.....12-17
12-23 Water meters, Youngstown, Ohio.12-17
12-28 Pumping plant, Cuba 12-17
1- 2 Fire hydrants, Louisville, Ky.....12-17
1- 4 Tank and tower, Minerva, Ohio...12-17
1-12 Water-works, Connersville, Ind..12- 3
1-15* Cement, Portland, Ore.....11-26
2-22* Pump, Winnipeg, Man.....12- 3

SEWERS.

12-18 Sewers, Louisville, Ky.....12- 3
12-18 Sewer, Marion, Ind.....12-17
12-18 Sewers, Columbus, Ohio.....12-17
12-21* Sewers, Muskogee, Okla.....12-10
12-21 Drain pipe, National Soldiers' Home, Va.....12- 3
12-21 Sewers, Green Bay, Wis.....12-17
12-22* Disposal plant, Oxford, Ohio.....12-17
12-22 Sewerage system, etc., Mount Vernon, Ohio 12- 3
12-23* Sewer, Louisville, Ky.....12-10
12-23 Sewers, Alliance, Ohio.....12-17
12-23 Sewers, Long Island City, N. Y..12-17
12-27 Sewer, Fort Wayne, Ind.....12-10
12-28 Sewer, Pipestone, Minn.....12- 3
12-30* Sewers, Louisville, Ky.....12-10
1-13 Sewage disposal plant, Polk, Pa..12-17
1-14* Sewer system, etc., Danville, Pa.12-17

STREETS AND ROADS.

12-17 Grading, etc., Cleveland, Ohio...12-10
12-17 Paving, etc., Fort Myer, Va.....12-10
12-17* Grading, etc., Newton, N. J.....11-19
12-18 Roadway, Sacramento, Cal.....12-17
12-18 Grading, etc., Zanesville, Ohio...12-10
12-21 Street impvt., St. Paul, Minn....12- 3
12-21 Repaving, Fort Wayne, Ind.....12-17
12-22 Paving, Princeton, Ill.....12-17
12-22 Sidewalks, Opelousas, La.....1-210
12-23 Road impvt., Cleveland, Ohio....12- 3
12-23 Paving, etc., Brooklyn, N. Y....12-10
12-23 Road impvt., Pittsburg, Pa.....12-10
12-23 Paving, etc., Roanoke, Va. 12-10
12-23 Regulating, etc., Brooklyn, N. Y.12-17
12-24 Curbstones, etc., New York.....12-17
12-24 Sewers, New York.....12-17
12-28 Road, Noblesville, Ind.....12-10
12-28 Roads, Anderson, Ind.....11-26
12-29 Street impvt., Canton, Ohio.....12-17
12-30 Regulating, etc., Brooklyn, N. Y.12-17
12-31 Road, Kokomo, Ind.....12-17
1- 1* Grading, etc., Humboldt, Tenn...12-17
1- 2 Sidewalk, Griffith, Ind.....12-10
1- 4 Road, Crawfordsville, Ind.....12-17
1- 4 Roads, Greenfield, Ind.....12-17
1- 4 Roads, Tipton, Ind.....12-17
1- 5 Road, Wabash, Ind.....12-17
1- 6 Road, Madison, Ind.....12-17

MISCELLANEOUS.

12-17* Crematory, Fort Strong, Mass. (Garbage) 11-26
12-17 Sluice gates, Grand Rapids, Mich.12-10
12-17 Levee, New Orleans, La.....12-17
12-18 Dredging, St. John, N. B. 12-10
12-19 Grand stand, Carthage, Ohio....12- 3
12-21 Supplies, Panama 12- 3
12-21 Hose, Hartford, Conn.....12-10
12-22 Dredging, Albany, N. Y.....11-26
12-22 Lumber, Philippines 12-17
12-22 Retaining wall, Cleveland, O....12-17
12-22 Lumber, New York 12-17
12-23 Steamboat supplies, Baltimore, Md. 12-17
12-24 Cement, New York 12-17
12-24 Oil, stone, New York.....12-17
12-24* Seawall, Fort Morgan, Ala.....12- 3
12-29 Tile drain, Rockwell City, Iowa..12-17
12-29 Subway, Boston, Mass.....12-27
12-31* Powder hoists, Wash., D. C.....12- 3
1- 2 Ditch, St. Paul, Minn.....12-27
1- 6 Ditch, Houston, Tex.....12-17
1- 9 Ditch, Anoka, Minn. 12-10
1-15 Cruiser, Ottawa, Ont.....12- 3
1-15* Dredging, Mobile, Ala.....12-17
2-13 Drydock, Hawaii 12-17

CIVIL SERVICE.

12-29 Teacher, etc., Philippines.....12-17
1- 4 Assistant, Philippines 12-10
1- 6 Hull Draftsman, Wash., D. C.....12- 3
1- 6 Inspector of Boilers, Wash., D. C.12-10
1- 6 Asst. Engr., Wash., D. C.....12-10
1- 6 Draftsman, Wash., D. C.....12-10
1-13 Junior physicist, Washington, D. C.....12-17
1-13 Chemist, Dover, N. J.....12-17
1-13 Electrician's helper, Washington, D. C.....12-17
1-13 Metallographist, Watertown, Mass 12-17

RAILWAYS.

ADIRONDACK & ST. LAWRENCE.—Survey is under way for an extension to be built from Herman to Clifton, N. Y., 24 miles. H. F. Timerman is Supt., Hermon, N. Y.

ALLEGHENY & NORTHWESTERN.—Chartered in Pennsylvania, with $70,000 capital, to build between Mars and Evans City, Pa., seven miles. The directors are John G. McPherson, Pres.; David Dillinger, William E. Heller, C. S. Jarvis and J. L. Killip, all of Philadelphia.

ARTESIAN BELT R. R.—Rails, ties and bridge timber are now on the ground and grading is nearly completed betwen Macdona and Kirk, Tex. As previously noted, the line has been surveyed and located, and contract for grading, track and surfacing has been let to the J. F. BURNS CONSTRUCTION CO., of Devine, Tex. The railroad will extend from Macdona on the Southern Pacific Ry. not far west of San Antonio, to New Artesia and to Simmons City, in Live Oak County, Tex., between 20 and 30 miles. Contract is to be completed by June 1, 1909. At the present survey will be made for the latter portion of the line, and then it will be arranged to extend further toward the Rio Grande. William Bradburn is Ch. Engr., 215 Alamo Plaza, San Antonio, Tex. Capital stock, $70,000. Charles F. Simmons is Pres., Excelsior Springs, Mo.

BUFFALO CREEK & GAULEY.—Company is planning to build an extension from Cresmont to Huttonville, W. Va., 99 miles. J. G. Bradley is Supt., at Clay, W. Va.

CALIFORNIA, NEVADA, IDAHO & NORTHERN.—Construction is said to be now under way by the CANYON CONSTRUCTION CO., of Caldwell, Idaho, which is building this line from Caldwell west to Homedale, 17 miles. Surveys are made beyond Homedale south to Jordan Valley, Ore., 60 miles. F. H. Richardson is Ch. Engr., Caldwell.

CANADIAN NORTHERN.—D. D. Mann, Vice-Pres., states that the Morinville branch will be extended to Athabasca Landing, Alta., providing the Government will guarantee the necessary bonds. As the Government has already consented to do so, construction is expected to start in the spring. M. H. McLeod is Gen. Mgr., Winnipeg, Man.

CAROLINA, CLINCHFIELD & OHIO.—Application for a charter has been made in South Carolina. Company proposes to build a new line from Cowpen Ridge, S. C., to Columbia, S. C., 100 miles. M. J. Caples is Vice-Pres., Gen. Mgr. and Ch. Engr., at Johnson City, Tenn. Fully noted on Oct. 22. In the application for incorporation the route is not stated. It is stated that Spartanburg, S. C., is a terminal. The capital stock is placed at $30,000,000, and the application is signed by William H. Lyles, of Columbia; George L. Carter, of Johnson City, Tenn.; A. A. Phlegan, of Bristol, Tenn. The charter also states that the line is chartered in Virginia and that 108 miles have been built. According to present plans, Spartanburg will be a terminal and another terminal is a point near Island Ford ferry. Of the line, 108 miles have already been constructed and the total length is 244 miles. The plans so far call for at least 20 miles in South Carolina. The head office is St. Paul, Va., and the line at present begins in Russell County, Va.

CUMBERLAND VALLEY.—Improvements in the vicinity of Mechanicsburg, Pa., planned by that company, will cost about $500,000, it is announced. M. C. Kennedy is Vice-Pres. and Gen. Supt., Chambersburg, Pa.

DYERSBURG NORTHERN R. R.—An extension will be built from Tiptonville, Tenn., to Bottom Number Nine, nine miles. R. M. Hall, Pres. and Gen. Mgr., Dyersburg, Tenn.

FRANKLIN & ABBEVILLE.—It is stated that this company has projected an extension from David Junction, La., north to Youngsville, 15 miles, and from Franklin and Abbeville Junction south to Franklin, six miles. W. Y. Kemper is Ch. Engr., Franklin, La. Jules Godchaux is Gen. Mgr., Raceland, La.

GRAND TRUNK PACIFIC.—M. P. & W. H. DAVIS, Ottawa, Ont., have been awarded contracts for construction work in the following sections: Districts D and E—From the western end of Fauquier Bros.' Abitibi contract, westerly for 104 miles. District E—From a point about 60 miles west of the easterly boundary of this district in an easterly direction to the west of Fauquier Bros.' contract, north to Lake Nepigon, about 100 miles. This work is to be completed by Dec. 31, 1910.

GULF & MAGNOLIA NORTHERN.—We are officially informed that location surveys are now being made for this proposed railroad which will be built from Magnolia, Ark., northwest via Waldo to Hope, 40 miles. Right-of-way and capital are secured. Contracts will be let about Feb. 1. W. Y. Foster, Pres., Hope; J. M. Davis, Vice-Pres., Waldo, and J. L. Davies, Treas., Magnolia. The headquarters of the company are at Hope. C. N. Black is Ch. Engr., Hope.

HELENA, PARKIN & NORTHERN.—This company has been chartered to build a line about 50 miles long from Whitmore, Ark., the Rock Island line, to Marked Tree, Ark., on the Frisco. Capital, $250,000, of which $100,000 is paid in. The incorporators are T. E. Hare, T. S. Hare, D. S. Watrous, G. Casey and J. L. Hare, of Parkin, Ark.; A. C. Stebbins, H. L. Thompson, E. F. Cooley and E. W. Sparrow, of Lansing, Mich.

INDIAN CREEK VALLEY.—This company, it is announced, is making surveys for an extension from Roger Mills, Pa., north to Jones Mills, ten miles. A further extension is projected north from Jones Mills to Ligonier, 16 miles. Chas. F. Hood, Pres. and Gen. Mgr., Connellsville, Pa.

LAKE ERIE & EASTERN.—The Pittsburg "Post" states that "in the next two years $5,000,000 will be spent putting the Lake Erie & Eastern R. R. through Youngstown, Ohio, with no grade crossings. A franchise in Youngstown for a four-track road will be asked. The right-of-way has been secured from Struthers to Girard, $2,000,000 being expended for it. The road is to be a New York Central line and will parallel the Erie, the Baltimore & Ohio and the Pensylvania roads, running on the south side of the Mahoning River for the most part, but crossing it twice in Youngstown at the plants of the Carnegie Steel Co. Work on the line is expected to begin next spring."

NEVADA-CALIFORNIA-OREGON.—The extension of this road has been finished from Likely, Cal., north to Alturas, 20 miles. Geo S. Oliver is Ch. Engr., Reno, Nev.

OCILLA SOUTHERN.—Contract has been given to R. S. TALMAGE, of Ocilla, Ga., for building this line, from Ocilla south to Allapaha, 17 miles, thence to Nashville, 13 miles. J. A. J. Henderson, Ocilla, is Ch. Engr. Noted on Nov. 12.

PANACEA R. R.—Application will be made in Florida for a charter for the company to build a railway from a point on the Georgia, Florida & Alabama Ry. at or near Sopchoppy or Ashmore, Fla., to a point at or near Vereen, Fla., 24 miles. Capital, $50,000. The incorporators are W. E. Smith, of Attapulgus, Ga.; C. C. Brown, of Bainbridge, Ga.; G. W. Hagan, of Iron City, Ga.; S. Brinson, of Brinson, Ga., and Thomas H. Hall, of Tallahassee, Fla. The officers are W. E. Smith, Pres.; T. H. Hall, Vice-Pres.; C. C. Brown, Treas. and Secy.

ST. MARYS & KINGSLAND.—Company will build with its own forces an extension from Kingsland, Ga., northwest to Waycross, 48 miles. A further extension west is projected from Waycross to Nashville, 50 miles. The road is now in operation from St. Marys, Ga., on the St. Marys River, near the Florida boundary, northwest to Kingsland, eleven miles. L. Johnson is Pres., St. Marys.

TOPEKA-SOUTHWESTERN.—The Topeka-Southwestern Construction Co., of Topeka, Kan., informs us that it will build and equip a standard steam railway for the Topeka-Southwestern Ry. Co., from Topeka to Council Grove, Kan., 60 miles. The preliminary work has been accomplished and construction is under way. A. G. Goodwin is Secy. of the construction company.

TUSCARORA VALLEY.—Surveys have been made for an extension from the present southern terminus at Blairs Mills, Pa., southwest to McConnellsburg, 27 miles. N. H. Suloff is Gen. Mgr., Port Royal, Pa.

VICTORIA & BARCLAY SOUND.—This company will be incorporated with powers, rights and privileges to build, equip and operate a railway from Victoria, B. C., via Otter Point and San Juan, to a point on Barclay Sound, near the Sarita River. W. H. Langley, Victoria, B. C., is acting for the company.

WESTERN MARYLAND.—We are officially advised that contract has been let to the BALDWIN LOCOMOTIVE WORKS, Philadelphia, for ten consolidation engines and three switching engines; and contract to the CAMBRIA STEEL CO., Johnstown, Pa., for 500 new steel hopper cars. A. Robertson, Vice-Pres. and Gen. Mgr., Baltimore, Md. Noted on Nov. 5.

ELECTRIC RAILWAYS.

BURLINGTON, VT.—The Burlington & Vergennes Traction Co. has been incorporated to construct an electric railway from Burlington to Vergennes. Incorporators: John J. Flynn, A. O. Humphrey, C. W. Brownell, Elias Lyman, L. E. Woodhouse and W. B. McKillip, Burlington; Edward P. Hatch, New York; and E. F. Gebhardt and C. M. Russell, Shelburne, Vt.

DANBURY, CONN.—It is announced here that the sale of the Danbury & Harlem Traction line by public auction has been ordered by the Supreme Court of New York State. The sale is to take place in White Plains, N. Y., on Jan. 23. The Danbury & Harlem Traction railway is a partially completed electric line designed to connect this city with Goldenbridge, N. Y., Its powerhouse is located on the outskirts of this city and about seven miles of the line is completed, rails laid and wires strung. James E. Walsh, 60 Wall St., New York, is Counsel.

NEW YORK, N. Y.—The Queensboro Bridge & Jamaica Co., with capital of $200,000, organized to operate an electric road 20 miles in length, and the Manhattan & Queensboro Ry. Co., with capital of $40,000, formed to operate an electric road 3½ miles long, have filed certificates of incorporation with the Secretary of State. The former road is to extend "from the west line of the Plaza or terminal leading to Queensboro Bridge at 42d St. and Park Ave., to Union Hall and South St., and the proposed new Pennsylvania Railroad station, Archer Place and Hillside Ave. and Wexford Terrace, on property of the Jamaica Estates, and at Pauline St., Queens County." The Manhattan & Queensboro Railway Co. is to operate from Eleventh Ave. and 57th St., New York, to Thompson Ave. and Van Dam St., Long Island City. Directors of both companies are Stuard Hirschman, Michael J. Degnon,

Charles G. Meyer, Arthur B. Turner, Francis Gilbert, Stewart W. Eames and William F. Hencken, of New York; William H. Williams, Jr., of Astoria, Long Island, N. Y.; and Clancy D. Boynton, of Perth Amboy, N. J. Principal offices are at 43 Exchange Place, New York.

PITTSBURG, PA.—A charter has been issued to the Banksville & West End Street Ry. Co., to build three miles of line in the vicinity of Banksville, Allegheny County. The company is capitalized at $18,000, and W. E. Kusen, of Pittsburg, is Pres. Noted on Nov. 26.

The Scott Township Street Ry. Co. has been chartered to build a 5-mile electric railway in Scott Township, from the intersection of Washington Ave. and the Hope Hollow Turnpike Road, to the line dividing Scott and Baldwin Townships. Capital stock, $30,000. Directors: W. E. Kusen, Pittsburg, Pres.; A. J. Schmidt, C. August Stuetz, W. P. Heckman and J. D. C. Miller. J. T. Barr, 237 Fourth Ave, Pittsburg, is Ch. Engr. Noted on Nov. 26.

BEAVERSDALE, PA.—We are officially advised that construction contracts probably wil be let during the winter by the Mount Carmel & Locust Gap Transit Co. The line will be 2¼ miles long, running from Beaversdale to Locust Gap. Surveys are made and capital secured. Right-of-way has not been obtained yet. E. W. Samuel is Pres., Mt. Carmel, Pa. Charter was recently granted to this company. Capital, $30,000.

PARKESBURG, PA.—The property of the Philadelphia, Coatesville & Lancaster Electric Ry. Co., which has defaulted payment on the interest of its first mortgage bonds for $600,000, recently due, will be sold here on Dec. 30, it is stated. Chas. Fifer, Chamber of Commerce Bldg., Cleveland, Ohio, is Supt.

TUPELO, MISS.—V. C. Kincannon is interested in plan to promote the Tupelo, Pontotoc & Fulton Electric Railway.

JACKSON, MISS.—The Mississippi Belt Line & Terminal Co. has applied to the Board of Aldermen for right-of-way and authority to build a belt line in this city. The company is composed of R. V. Powers, W. Q. Cole, L. B. Cheatham and R. L. Bradley.

ASHEVILLE, N. C.—The Asheville & Carolina Ry Co. has let contract to the CAROLINA CONSTRUCTION CO., of Asheville, for building its line. It will extend from Asheville through Hendersonville, largely following the country road on private right-of-way from Biltmore South, to Greenville, a distance of about 75 miles. The first section, to be built will be from Asheville to Hendersonville and the contract for this work has been let. While the railroad company will be in effect one organization it is composed of two corporations in order to comply with the charter laws of North and South Carolina. The company in North Carolina is chartered as the Asheville & Carolina Ry. Co., and that in South Carolina, which will build from the state line to Greenville, as the Greenville & Carolina Ry. Co. The officers of the Asheville & Carolina are: Chas. A. Webb, of Asheville, Pres.; P. F. Patton, Vice-Pres., Hendersonville; John F. Rowland, of Hendersonville, Treas.; C. F. White, of Asheville, Secy. The board of directors is composed of these officers and S. Lipinsky and F. Rogers Grant, of Asheville, Dr. W. R. Kirk, of Hendersonville. The officers of the Greenville & Carolina Ry. are: T. E. Smith, of Greers, S. C., Pres.; L. W. Walker, of Spartanburg, S. C., Secy. and Treas., the other directors being J. A. Bull, of Chick Springs, S. C., and J. W. Kendrick, of Taylor, S. C. Work is to begin as soon as all right-of-way is obtained, probably by Jan. 1. The entire road is to be a modern high speed interurban railway with concrete masonry and steel bridges and the specifications call for construction of the type of the heaviest steam road. V. E. McBee is Pres. and Ch. Engr. of the Carolina Construction Co. Previously noted.

CINCINNATI, OHIO.—W. J. Harvey & Co., Box 367, Cincinnati, are reported to be in the market for proposals on: Ties, 80,000; rails, 70-pound, 20,000 tons; 200 kegs spikes; copper, 4% trolley, 300,000 lbs.; copper, 7% feeder, 80,000 lbs.; two 300-HP. engines; two 300-KW. generators; two 300-HP. boilers; six interurban passenger cars; four closed interurban freight cars; six open freight cars; two 50-ton electrical engines.

BROWNSTOWN, IND.—The County Commissioners have ordered a special election to be held in Brownstown and Jackson townships, Jan. 12, to vote upon a subsidy for an electric line between this city and Seymour, to connect at the latter place with the Indianapolis & Louisville traction line.

BATTLE CREEK, MICH.—William V. Jacobs, Battle Creek, is interested in plan to connect Battle Creek, Kalamazoo and Grand Rapids with an electric railway.

DE KALB, ILL.—The De Kalb Midland Ry. Co. has been incorporated to construct an electric railway from De Kalb to Sandwich. Capital stock, $150,000. Incorporators: John W. McQueen, Herbert J. Burdick and William G. Wilcox, Elgin, Ill., and O. Fred. Cole and John F. Pearce, Chicago.

EAST ST. LOUIS, ILL.—Construction probably will not be started until next spring by the East St. Louis, Columbia & Waterloo Ry. It has completed its surveys and secured most of the right-of-way for its proposed electric road, which is to be built from East St. Louis through Dupo, Bixby, East Carondelet, Columbia and Waterloo, Ill. The overhead trolley system will be used. Headquarters, Columbia, Ill. Officers: E. F. Schoening, Pres.; J. W. Warnock, Vice-Pres.; H. Reichenbach, Secy. and Treas., all of Columbia. Baxter Brown, Merchants-Laclede Bldg., St. Louis, Mo., is Ch. Engr.

DES MOINES, IOWA.—The Des Moines & Sioux City Ry. has let contract to the AMERICAN ENGINEERING CO., Chas. N. Wilson, Pres., Terminal Bldg., Indianapolis, Ind., for the construction of this company's projected line from Des Moines through Adel and Perry to Sioux City, a distance of 196 miles. Work is to begin on or about Dec. 20. The contracts call for standard construction and the estimated cost is $25,000 per mile, including equipment; total, $4,700,000. A branch line will be built to Fort Dodge; then a line from Sioux City to Council Bluffs and Omaha, a distance of 60 miles, and also a line from Council Bluffs to Des Moines, a distance of about 150 miles. Noted on Nov. 19. The officers of the Des Moines & Sioux City Ry. Co. are: Pres., J. P. O'Malley, Perry, Iowa; Vice-Pres., J. R. Doran, Beaver, Iowa; Secy., E. D. Carter, Berkley, Iowa; Treas., J. W. Russell, Adel, Iowa. The headquarters are in Des Moines.

HELENA, ARK.—J. W. Burks has applied to the City Council for a franchise for a street railway system.

FORT WORTH, TEX.—Contract has been awarded to CHARLES B. DUFFY, of St. Louis, Mo., by Stuart Harrison and R. H. McNatt, of the Fort Worth Board of Trade, for building an interurban electric railway from Fort Worth via Springtown to Mineral Wells, Tex., about 62 miles, provided that the three counties traversed subscribe for $360,000 of stock, the total being $1,400,000. Subscriptions are to be paid when the road is completed.

SAN DIEGO, CAL.—The South San Diego & Imperial Beach Ry. Co. has been incorporated to construct an electric railway from the south end of the bay of San Diego to Imperial Beach. Franchises for about three miles of this proposed road have already been granted by the Board of Supervisors and nearly two miles of the road have been built, it is stated. Capital stock, $25,000, of which $15,000 has been subscribed. Incorporators: G. Y. Gray, E. W. Peterson, R. B. Thomas and R. A. Smith.

LIGHT AND POWER PLANTS.

(denotes that this work is advertised in Engineering News.)*

GREENVILLE, ME.—The Greenville Light & Power Co. contemplates extending its transmission line to Monson, Me., to furnish electricity for motors to the slate works. The company will furnish electrical service in the town of Monson also. H. D. Sawyer, Greenville, is Mgr.

ESSEX JUNCTION, VT.—We are officially advised that the Burlington Light & Power Co. will develop the water power privileges at Essex Junction at the Hunter & Shiland and the Brownell privileges on the Winooski River. As noted on Nov. 19, the company will build a dam below the present Hunter & Shiland dam of concrete. From it there will be a fall of 75 ft. The boulders in the bed of the river above the Brownell dam are to be removed, giving a free water runaway. The height of the new dam will set the water back as far as the iron bridge on the Central Vermont Ry. and this storage basin will hold a volume of water forming a lake. A powerhouse will be constructed below the dam on the Essex side of the river, near the site of the present Brownell saw mill. Work on this undertaking will be begun early in the spring. It is expected that the power will be ready to be utilized before the winter of 1909 sets in. J. J. Kennedy, 52 Broadway, New York, is Engr.; F. H. Parker, Burlington, is Mgr. Estimated cost, $250,000.

LEE, MASS.—The Smith Paper Co. has entered into a contract with the LEE ELECTRIC CO. to furnish electricity for lamps for the Columbia, Centennial and Niagara mills.

GREENFIELD, MASS.—Plans are being made by the Greenfield Electric Light & Power Co. to separate its lighting and power circuits by the erection of new lines. The cost of the work is estimated at from $4,000 to $5,000. G. W. Lawrence, Greenfield, is Supt.

NEW BRITAIN, CONN.—The New Britain Gas Light Co. has voted to increase its capital stock from $300,000 to $400,000, to be called in at the petition of the Directors. H. M. Belle is Supt.

NEW YORK, N. Y.—Bids are asked until 2.30 p. m., Dec. 23, by Robert W. Hebberd, Comr. Dept. Pub. Charities, for the complete conduiting, electric wiring, and all other work in connection with the installation of a complete electric lighting and power system for certain of the buildings and grounds under the jurisdiction of the Department of Public Charities, City Hospital District, Blackwell's Island, Boro. of Manhattan.

NEW YORK, N. Y.—Plans have been filed by Axel S. Hedman, Arch., acting for Frederick W. Whitridge, Receiver, for a powerhouse to be erected for the Union Ry. Co. on Brook Ave., north of 165th St., at a cost of $30,000.

NEW YORK, N. Y.—Bids are asked until 10 a. m., Dec. 29, by Theodore A. Bingham, Police Comr., for furnishing all the labor and materials required in making and completing electric light and power installation throughout the Police Department stable, 153 and 155 East 32d St., Boro. of Manhattan, for the Police Department of the City of New York.

Bids are asked by C. B. J. Snyder, Supt. School Bldgs., Dept. of Education, until 11 a. m., Dec. 28, for installing electric equipment in new Public School No. 114 on James, Oak and Oliver Sts., Boro. of Manhattan.

ROCHESTER, N. Y.—The Rochester Railway & Light Co., Rochester, N. Y., has decided to equip the Commercial St. power plant, known as Station No. 1, with oil-burning apparatus, in case of emergency. It is expected that the 750,000-gallon oil tank, which the company is building below Platt St., will be completed within the next two weeks, and the supply of oil to be used at No. 1 Station will be drawn from it. R. M. Searle, Rochester, is Gen. Mgr.

BUFFALO, N. Y.—Plans are being considered by the Niagara, Lockport & Ontario Power Co. for the erection of a transmission line in this part of the State. The plans call for the construction of a penstock for the passage of water at Niagara Falls. The conduit will be about a mile in length, and will cost about $750,000. F. B. H. Paine, Buffalo, is Gen. Mgr.

NEW YORK, N. Y.—See item under Manufacturing Plants.

WARREN, PA.—Bids are asked until Dec. 18 by the Building Committee of the Board of Trustees of the State Hospital for the Insane at Warren, Pa., for furnishing and installing two natural gas engines, electric generators and switchboards in the electric light and power plant. S. W. Waters is Secy. of the Bd. and J. W. Greenland, Steward.

SCRANTON, PA.—PETER SKIPP, of this city, has been awarded the contract for the construction of the proposed power plant of the Scranton Ry. Co. to be erected on the Diamond Flats in the rear of the present plant. The contract provides for the construction of a boiler room 75 × 120 ft. for the accommodation of 16 boilers, an engine, 60 × 60 ft., and a retaining wall along the Lackawanna River. The buildings will be of reinforced concrete, and when the plant is opened it will have a capacity of 2,400 HP., which is twice the capacity of the present plant. Frank Caum is Pres.

BALTIMORE, MD.—Arrangements are being made for building the extension to the underground conduit system, for which $1,000,000 has been appropriated. Plans will be completed about Jan. 1. C. E. Phelps is Ch. Engr. of the Electrical Comn.

WASHINGTON, D. C.—Bids are asked until 2 p. m., Dec. 17, by Bernard R. Green, Supt. Construction, National Museum, for furnishing, delivering and installing in place with all connections complete, the generator switchboard and connecting cables, and for the steam pumps required for the new building for the National Museum, in this city.

BURLINGTON, N. C.—Plans are being considered by the Light and Power Department to change the municipal electric plant from single to 3-phase for the day power circuit. O. P. Dickson is Mgr.

FRANKFORT, KY.—Bids are asked at the office of the Board of State Capitol Commissioners, Frankfort, Ky., until Jan. 5, for furnishing and installing the electric light fixtures required in the new State Capitol at Frankfort, Ky. Frank M. Andrews & Co., Cincinnati, Ohio, and Waldorf-Astoria, New York, N. Y., are Archs.

BELLEVUE, KY.—We are officially advised that the City Council has authorized that plans and estimate of cost for a municipal electric light plant be prepared. George Hornung & Son, Consult. Engrs., Johnston Bldg., Cincinnati, Ohio.

LIMA, OHIO.—Bids will be received by the Board of Public Service, Lima, Ohio, until Dec. 21, for furnishing machinery, material and labor required in connection with the construction of an electric light plant. The specifications call for water-tube boilers, breeching and stock, steam and electric prime movers, steam plant auxiliaries, exhaust and water piping valves and fittings; lighting equipment, pole line construction, erection of wires, etc. C. E. F. Ahlm, 614 Caxton Bldg., Cleveland, Ohio, is Engr.; L. L. Crumrine is Secy. Bd. Pub. Service, Lima.

CLEVELAND, OHIO.—At a special meeting of the County Building Commission, held on Dec. 4, it was decided to engage Harry W. Woodward, of the Cleveland Engineering Co., New England Bldg., Cleveland, together with French & Hubbard, Albany Bldg., Boston, Mass., to design and erect the power plant for the court-house which is to be built on West Tenth St., near Main Ave. Considerable excavating will be done and a retaining wall built to keep adjoining buildings from sliding. A tunnel for the steam pipes and wires will be bored from the site to the court-house, a distance of several blocks.

CINCINNATI, OHIO.—We are officially advised that the following bids were received on Dec. 11 by Col. William T. Rossell, Corps Engrs., U. S. A., Cincinnati, for building a power-house at Dam No. 37, Ohio River—(a) amount of bid, (b) alternate bid, chimney built according to Custodis construction: Robert Harris, Newport, Ky., (a) $14,387; Kaps & Brehm, Cincinnati, Ohio, (a) $12,200; Gordon Engineering Co., Builders' Exchange, Cincinnati, Ohio, (a) $13,334, (b) $13,459; L. P. Hazen & Co., 1610 Reading Road, Cincinnati, Ohio, (a) $13,422; William Miller & Son, 2020 Elm St., Cincinnati, Ohio, (a) $13,739; M. Marcus Building Co., 1513 Plum St., Cincinnati, Ohio, (a) $13,071, (b) $13,231.

NEWCASTLE, IND.—The City Council has awarded a contract to the JOHN A. STUART CO., of Cincinnati, Ohio, to install an engine, generator and other equipment in the city electric light plant. W. A. Shaff, Newcastle, is Mgr.

ESCANABA, MICH.—The Escanaba Electric Pulp & Power Co. has been reorganized under the name of the Escanaba Power Co., and the following officers elected: P. L. Utley, of Escanaba, Mich., Pres.; J. M. Molloy, of Watertown, Mich., Vice-Pres., and M. N. Smith, of Escanaba, Secy. and Treas. The company has decided to construct a second dam in Escanaba River, near Groos. The power will be used to operate a pulp board plant and other industries.

PINCONNING, MICH.—The Eastern Michigan Power Co. has been granted a 30-year franchise in Pinconning to erect its transmission lines through the town. The company is planning to extend its system to the towns along the Detroit and Mackinac and Michigan Central railroads to furnish electricity for lamps and motors.

TRAVERSE CITY, MICH.—The plans are completed for the dam of the Boardman River Electric Light & Power Co., and work on the structure will be begun in the spring. The dam will have a 42-ft. head and between 3,000 and 3,500 HP. will be generated. The dam will be constructed of concrete. W. S. Cook is Mgr.; W. G. Pargo is Engr.

ST. PAUL, MINN.—It is stated that specifications for street lighting as prepared by the Board of Public Works and presented to the Board of Aldermen call for the installation of 2,000 additional lamps during the coming year.

McCOOK, NEB.—The M... Light Co. is planning to c... tric plant, to be equipped w... bine unit. The cost of the p... at $35,000. I. Hale, Denver... Mgr.; A. R. Scott, McCook.

LIVINGSTON, MONT.—N... Ry. Co. engineers are in Liv... on a plan to use electricity in... over the Rocky Mountains... at some point on the Yello... planned. W. L. Darling, S... is Ch. Engr.

AFTON, OKLA.—Plans are... develop the water power of ... generate electricity for distri... and other towns in this part ... site has been selected about ... Afton, where a dam will b... stated. Surveys and estimates... power of the Grand River ha... by Capt. J. Odell, of Joplin... Joplin Light & Power Co., of ...

MARLOW, OKLA.—Plans ar... sidered for improvements to ... electric light plant and water-w... the cost of which is estimate... Ben Boon, Marlow, is Supt.

ROSEBURG, ORE.—The Alam... Consolidated Mines Co. is making arra... the development of a water po... 6,000 to 8,000 HP., it is stated... pany proposes to construct an ... way to some convenient point o... ern Pacific R. R.

LOS ANGELES, CAL.—The B... of Supervisors of the County of Los ... passed an ordinance granting J... a franchise to construct and ... electric pole, wire and conduit sy... County of Los Angeles. C. E. ... Chn. Bd.

LA GRANGE, CAL.—The La Gr... Water & Power Co. contemplates installi... additional 40-KW. unit and exciter and water wheel in its plant; also transformers to transform the current from 10,000 to 3... volts. John Coffee Hayes is Vice-Pres. and Mgr.

HADEN, IDAHO.—Julian M. De Coster, of Haden, and Fred T. Mitchell are interested in a project to develop the water power of Teton River, it is stated. A company has been organized under the name of the Teton River Power Co., which has secured rights to a 156-ft. fall of water on Teton River.

BERLIN, ONT.—The Algoma Power Co. is planning to install a 300-KW. unit in its plant at Michipicoten Falls, Ont., when the present extensions are completed. C. H. Mitchell, Traders' Bank Bldg., Toronto, Ont., is Consult. Engr.

FORT FRANCES, ONT.—The sum of $3,000,000 is to be turned over to the Minnesota & Ontario Power Co. at once for the purpose of completing the dam being constructed across the Rainy River at this town, according to the "Contract Record," of Toronto, Ont. It is intended to develop the water power and construct a ground wood pulp mill, sulphite pulp mill, four machine paper mills, and other buildings necessary for the manufacture of ground wood and sulphite pulp and paper. When this amount is expended for the purposes named, the remaining $2,000,000 will be available to complete the work. Warren Curtis is Gen. Mgr.

LETHBRIDGE, ALTA.—We are advised by Smith, Kerry & Chace, Engrs., Confederation Life Bldg., Toronto, Ont., that the city will expend about $100,000 for a steam power plant to be built on the Belly River at Lethbridge. The city owns a plant which it purchased from a local company. The new station will have mechanical stoking, fuel economizers, surface condensers, and will include 450 KW. old machinery, 300 KW. new; a 2,000,000-gallon steam or electric pump and space for 500 KW. additional electrical machinery. The plans and specifications are ready. The plant will supply light and power to the town, which has a population of 7,000.

BRIDGES.

(denotes that this work is advertised in Engineering News.)*

WATERVILLE, ME.—The Lewiston, Augusta & Waterville Ry. Co. contemplate constructing a bridge over the Kenebec River between Winslow and Waterville in order to gain an entrance to the latter place. W. G. Parker is Elec. Engr., Lewiston.

FAIRPORT, N. Y.—Bids are asked by F. C. Stevens, Supt. Pub. Wks., Albany, until noon, Jan. 5, for constructing the superstructure, substructure and approaches for a highway bridge at Wappings, 2.5 miles west of here, Barge Canal contract No. 38, Erie Canal, Section 9.

OLEAN, N. Y.—At a special election held on Dec. 8 it was decided to build a bridge over the Allegany River at the foot of Clark St. Estimated cost, $13,000. E. E. Allen, City Engr., will prepare specifications.

SCRANTON, PA.—The Grand Jury has recommended that the County Commissioners construct 19 bridges.

MARTINSVILLE, VA.—The contract will be awarded on Dec. 17 for the construction of the iron bridge across Smith River at Satterfield Ford site. J. R. Gregory is City Engr.

NORFOLK, VA.—The Board of Control has recommended to the City Council the appropriation of $12,000 to provide for the construction of a reinforced-concrete arch bridge over north branch of Smith's Creek and concrete culvert for south branch on Duke St. W. T. Brooke is City Engr.

HANOVER, VA.—We are officially advised that bids were received as follows on Nov. 25 by the State Highway Commissioners, Richmond, for constructing a steel and reinforced-concrete bridge over Chickahominy River on the road from Fair Oaks to Cold Harbor, between Hanover and Hanrico Counties, (a) steel, (b) concrete, (c) alternate plan: T. J. Smith & Co. (b) $5,685; (c) $5,385; Roanoke Bridge Co., Roanoke, Va. (a) $3,690; W. Haw (a) $4,155, (b) $3,791;

Austin Bros. (a) $4,126; Thomas A. Barry Co. (b) $[illegible]; (c) $7,482; S. M. Prince, Canton Br[illegible] Co. (a) $4,850; E. J. Heaton (a) $4,2[illegible] $5,720, (c) $3,680; Stamper Bros. & Ra[illegible] l (a) $4,530, (b) $5,581, (c) $5,174; K[illegible] Machine Co. (a) $4,100, (b) $5,500; C[illegible] a Engineering Co. (a) $3,900; W. L. W[illegible] & Co. (c) $3,486, (b) $3,150, (c) $2,670 $2,586.

*AUGU[illegible]GA.—Bids are asked by the River, Bi[illegible]nd Wharves Committee of the City Cou[illegible]ntil noon, Jan. 12, for furnishing all [illegible] and material and constructing complete[illegible]pt piers, a steel bridge with draw sp[illegible] the Savannah River here, at the extr[illegible] of Fifth (Center) St. There will be c[illegible]pans of a total length of 928 ft. Nisbet W[illegible]ld is City Engr.

BIRM[illegible]AM, ALA.—The St. Louis & San Francis[illegible] R. Co., F. S. Rice, Engr. Bridges, [illegible]Louis, Mo., contemplates viaduct construc[illegible]in Birmingham. Estimated cost, $400,000.

*HAN[illegible]ORO, MISS.—Bids will be received [illegible]e City Clerk until noon, Jan. 1, for the c[illegible]ion of a steel draw-bridge across Bayou [illegible]ard within the corporate limits of the [illegible]. Plans and specifications can be had [illegible]pplying to the City Clerk.

GREN[illegible]K, MISS.—Bids are asked until Jan. 5 [illegible]the city for the construction of an iron bri[illegible] one span, 125 ft. long.

ALEXANDRIA, LA.—The Alexandria Electric Ry. Co. will construct a 200-ft. trestle across Bayou Robert. C. M. Waters is Pres.

CARLISLE, KY.—The Carlisle, Parks Ferry & Flemingsburg Bridge Co. has been incorporated to construct a steel bridge over Licking River, near Parks Hill. Capital, $10,000. E. T. Harding, of Millersburg, and George W. Flora, of Parks Ferry, are interested.

CINCINNATI, OHIO.—Bids are asked until noon, Jan. 8, by the Board of County Commissioners for the construction of bridges and culverts. Fred Dreihs is Clk. Bd.

SANDUSKY, OHIO.—Bids are asked until 2 p. m., Jan. 4, by the Board of County Commissioners for entire new floor system for the Hillsburg joint county bridge. Charles Kubach is County Audr.

NEWARK, OHIO.—Bids are asked until noon, Jan. 11, by the County Commissioners for the superstructures of two bridges. J. N. Wright is County Audr.

INDIANAPOLIS, IND.—Bids have been received as follows for the construction of a concrete arch over Pogues run, at Rural St., to replace the old wooden bridge: Yawger Construction Co., $4,621; G. W. Fife, $5,800; W. F. Hackerdorn & Co., $6,265.

PRINCETON, IND.—Contracts for the construction of bridges were awarded on Dec. 8 by the County Commissioners as follows: For 26 iron and steel bridges with concrete floors to the INDIANA BRIDGE CO., at $14,970; seven concrete bridges to AUGUST P. ELGENMAN, of Rockport, Ind., at $6,342.

LANSING, MICH.—The City Engineer has submitted plans and has estimated the cost of a bridge to be constructed over Cedar River at Cedar St. at about $35,000.

STREATOR, ILL.—F. W. Herbert, City Engr., has secured estimates for the construction of a bridge at Bridge St., and a bridge at Main St. According to the estimate the Main St. structure of reinforced concrete will cost about $175,000, and the Bridge St. structure about $50,000.

GREEN BAY, WIS.—The Cargill Coal Co. has awarded the contract to the MILWAUKEE BRIDGE CO., Milwaukee, Wis., for the construction of a new movable bridge, 270 ft. long.

CEDAR RAPIDS, IOWA.—Ira G. Hedrick, Twelfth and Paseo St., Kansas City, Mo., has been selected to prepare plans and specifications for a reinforced-concrete bridge over Cedar River at 16th Ave. T. R. Warriner is City Engr.

CROOKSTON, MINN.—We are officially advised that bids were received as follows on Dec. 7 by the city for the construction of Sampson's Addition bridge: (a) 213.5-ft. span, oak and creosote paving block floor, (b) 200-ft. span with one 40-ft. and one 20-ft. girder approach, oak and creosote paving block floor: Minneapolis Bridge & Iron Co., Minneapolis (a) $18,600 and $20,160, respectively, (b) $15,000 and $18,000; Hewitt Building Co., Minneapolis, (a) $18,300 and $19,800, (b) $15,000 and $17,400; A. Y. Bayne & Co., Minneapolis, $14,900; Fargo Bridge & Iron Co., (b) $14,000; Hennepin Bridge Co., Minneapolis, (a) $18,690 and $19,875, (b) $16,190 and $18,430; Canton Bridge Co., Omaha, Neb., (a) $19,120 and $20,000, (b) $16,500 and $18,795. The Minneapolis Bridge & Iron Co. made an alternate bid of $15,180 on a 213.5-ft. span, oak floor, with a live load of 2,000 lbs. per lin. ft. on trusses. Original proposals called for live load of 2,400 lbs. per lin. ft. on trusses. J. E. Carroll is City Engr.

MINNEAPOLIS, MINN.—Bids are asked by Hugh R. Scott, County Audr., until 11 a. m., Jan. 11, for furnishing repairs on bridge No. 1.

GENEVA, NEB.—Bids will be received until Jan. 12 by Uriah F. Stanard, County Clk., Geneva, for furnishing material and constructing all county bridges, both bent and pile, steel and wooden, required by the county for one year.

PLATTSMOUTH, NEB.—The Cass County Commissioners have awarded the contract for the construction of steel bridges for the ensuing year to the NEBRASKA CONSTRUCTION CO., of Lincoln, Neb.

ST. LOUIS, MO.—The Board of Public Improvements, A. J. O'Reilly, Pres., has prepared amended plans for the proposed new free bridge here. The new plans give a clearance between the center piers of 620 ft., and the bridge proper, three spans long, will be 2,000 ft. Only two of the four piers are to be within the 2,000 ft. of waterway lying between the inner harbor lines.

*KANSAS CITY, MO.—The contract for the steel construction work on the Main St. viaduct over the Belt Line Ry. tracks was awarded on Dec. 10 by the Commercial Improvement Co. to the BLODGETT CONSTRUCTION CO., 5 Water Works Bldg., Kansas City.

ARKADELPHIA, ARK.—The County Court has made appropriations for the construction of two bridges across the Caddo River, one at Cash Ford, four miles north of Arkadelphia, and one near Amity.

PARKDALE, ARK.—The contract for constructing a bridge across Bayou Bartholomew, bids opened on Nov. 30, has been awarded to the VINCINUS BRIDGE CO., of Monroe, La., at $7,991. H. Oliver is Clk. County Court.

PARIS, ARK.—Bids will be received until March 4 by Fred N. Cater, County Clk., Paris, for constructing the following bridges: Ode Bridge, over Sugar Creek at Em Scott Ford; over Petit Jean at Lucas Ford; over Scott Creek at Frank Scott Ford; over Cane Creek between Prairie View and Morrison Bluff; two bridges, one over Mill Creek and the other over Little Shoal Creek at Blaine Fords. J. W. Castleberry is County Judge.

HOUSTON, TEX.—H. L. Shaw, Engr., has submitted plans and specifications for a concrete viaduct from Travis St. to Montgomery Ave. to the Bridge Committee of the Business League. The structure as proposed will be of concrete, 1,300 ft. long, 52 ft. wide, with 16½-ft. driveway in center, street-car track, with protecting curbing on each side of driveway and railed-in sidewalk on each side of tracks, crossing Buffalo Bayou at a height of 55 ft. from water level, White Oak Bayou at a height of 50 ft. and street and railroad tracks at a height of 22 ft. Estimated cost, about $150,000. T. C. Tarver is City Engr.

PAWHUSKA, OKLA.—We are officially advised that contracts were awarded as follows on Dec. 8 for the construction of various bridges: Concrete bridge and three stone arch bridges to the WALTER SHARP CONSTRUCTION CO., Winfield and Eldorado, Kan., at $6,675 and $8,900, respectively; five steel bridges to the MISSOURI VALLEY BRIDGE & IRON CO., Leavenworth, Kan., at $30,678. H. J. Behning is County Surv.

DENVER, COLO.—The AMERICAN BRIDGE CO., Carnegie, Pa., has secured the contract, at about $400,000, for the steel work on the 20th St. viaduct to be erected for this city. H. S. Crocker is Engr.-in-Charge.

RIFLE, COLO.—CHAS. SHEELEY BRIDGE CO., 219 McPhee Bldg., Denver, Colo., was awarded the contract on Nov. 30 for the steel bridge to be constructed across the Grand River at Rifle, at $26,870. The contract calls for two spans, one 240 ft. long and the other 190 ft.

SPOKANE, WASH.—J. C. Ralston, City Engr., has completed plans for the construction of a concrete bridge at Monroe St.

SAN BERNARDINO, CAL.—The CHAS. SHEELY CO., 219 McPhee Bldg., Denver, Colo., has secured the contract for erecting three county bridges.

MONROVIA, CAL.—The CALIFORNIA ORNAMENTAL BRICK CO., McPherson St., Los Angeles, Cal., was awarded the contract by the Supervisors on Dec. 7 for constructing a 177-ft. 7-arch bridge over the Santa Anita wash between Pasadena and Monrovia, at $5,200. Eleven bids were received, ranging as high as $7,945.

STOCKTON, CAL.—Bids are asked by the Board of Supervisors of San Joaquin County until 10 a. m., Jan. 5, for the construction of two steel draw-span bridges, one 90 ft. and the other 249 ft., with a 60-ft. approach span and steel tubes for a foundation.

BUILDINGS.

(denotes that this work is advertised in Engineering News.)*

*SPRINGFIELD, MASS.—Bids are asked until 3 p. m., Jan. 20, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction complete of the extension to the U. S. post-office and custom-house at Springfield.

BOSTON, MASS.—Because the award of the contract for enlarging the Suffolk County Court-house to the second lowest bidder, Conners Bros., of Lowell, has been disapproved by the Governor, the Chief Justice and by George A. Hibbard, Mayor, the Special Court-House Commission has decided to call for new bids. These bids will be opened on Jan. 2 and the work must be finished within 27 months. The original request was for doing the work within 30 months, but the Commission has decided to cut the time to correspond to the period that has elapsed since the first award was made. A complete list of bidders for work on the first contract was published on Oct. 29, and a notice of the award to Conners Bros. was published on Nov. 12.

Mrs. Fannie E. Morrison will erect an 8-story mercantile building, to be known as the Demmon Building, at the corner of Harrison Ave. and Beach St. It will extend to the alley in the center of the block. The exterior will be of dark red Harvard brick, with a high base at the street line, of polished green granite, the string courses, the sills and cornice being of granite composite. There will be a steel frame of the skeleton type, the columns and the piers sustaining all the floor loads and the exterior walls, the floors being constructed with lines of steel girders, carrying reinforced-concrete spans of about 15 ft., making the building fireproof. The contract for the erection of the Demmon Building has been let to WHIDDEN & CO., 155 Milk St., Boston, and requires the building to be ready for occupancy not later than Oct. 1, 1909. It is the intention of the contractors to begin to raze the present buildings Jan. 1. The structure will cover 8,173 sq. ft. of land. The new structure is estimated to cost about $300,000. C. H. Blackall, 20 Beacon St., is Arch.

NEW BRITAIN, CONN.—W. H. Cadwell, Arch., 213 Main St., has prepared plans for a hotel to be erected here. It is proposed to organize a company with $150,000 capital stock to promote the enterprise.

NEW HAVEN, CONN.—Plans are being drawn for the Board of Education for the school house to be erected at Campbell Ave. and Brown St., West Haven. It is expected that the plans will be ready for figures in about two weeks. The building will be two stories high and basement, 75 × 102 ft. The basement will be arranged for play rooms and lunch room, the two upper floors containing eleven classrooms, teachers' room and room for the superintendent. The cost of the structure will be about $50,000 and it will be erected with a view of adding eight more rooms at some future time and will be fireproof throughout.

BUFFALO, N. Y.—John T. Coonan, 332 Pennsylvania St., will build a 3-story and basement store and apartment building at Front Ave. and Carolina St. of pressed brick, stone and structural iron. Cyrus K. Porter & Sons, Archs., 73 West Eagle St., have prepared plans and will receive bids.

CANASTOTA, N. Y.—The Methodist Episcopal Church of Canastota will erect a church building, 80 × 94 ft., of gray pressed and brick, with stone trimmings, structural steel and slate roof, to cost approximately $40,000. Merrick & Randall, Syracuse, N. Y., have prepared plans and will receive bids at once.

GLOVERSVILLE, N. Y.—Bellis & Kline will build a leather warehouse, 40 × 80 ft., two stories and basement, of brick, with composition roof. F. L. Comstock, Arch., 31 West Fulton St., is preparing plans and will receive bids.

BUFFALO, N. Y.—The Buffalo Orphan Asylum Association has authorized the preparation of plans by Esenwein & Johnson, Archs., 775 Ellicott Sq. Bldg., for the asylum buildings which are to be erected on Elmwood Ave., opposite Delaware Park, at an approximate cost of $200,000. There will be a group of four buildings, 368 × 208 ft., three stories and basement, connected by corridors, and comprising a main building, containing reception rooms, offices, dining rooms and library; a boys' ward building, a girls' ward building and an infants' ward building. Steel frame construction with pressed brick stone trimmings and slate roofs will be used. A power-house to supply power, heat and light will be built. Plans will be ready the early part of January and bids will be received in time to commence construction work about March 1.

NEW YORK, N. Y.—Bids are asked until 10.30 p. m., Dec. 28, by Nicholas J. Hayes, Fire Comr., for furnishing all the labor and materials required for repairs to heating systems in the quarters of the following companies in the Boroughs of Manhattan, the Bronx, Brooklyn and Queens:

Borough of Manhattan.—Engine Company 53, located at 175 East 104th St.; Engine Company 1, located at 165 West 29th St.; Engine Company 24, located at 78 Morton St.; Hook and Ladder Company 9, located at 209 Elizabeth St.; Hook and Ladder Company 11, located at 742 East Fifth St.; Hook and Ladder Company 25, located at 205 West 77th St.

Borough of the Bronx.—Engine Company 75, located at Jerome Ave. and 183d St.; Engine Company 68, located at 1116 Ogden Ave.

Borough of Brooklyn.—Engine Company 136, located at 998 Liberty Ave.; Engine Company 137, located at 55 Morgan Ave.; Engine Company 153, located at 86th St., near 24th Ave.; Engine Company 146, located at East 23d St., near Voorhies Ave., Sheepshead Bay; Engine Company 131, located at 107 Watkins St.; Engine Company 120, located at No. 530 Eleventh St.; Hook and Ladder Company 64, located at Fifth Ave., near 52d St.; Hook and Ladder Company 53, located at 181 Concord St.; Hook and Ladder Company 52, located at 893 Bedford Ave.

Borough of Queens.—Hook and Ladder Company 65 and Engine Company 158, located at 136 East Eighth St., Long Island City.

Louis Korn, 253 Fifth Ave., and Maximilian Zipkes, 147 Fourth Ave., Associate Archs., have been commissioned by the Elka Realty Co. to draw plans and specifications for a 12-story store and loft building to be erected at 40 and 42 West 22d St., on a plot 46 × 100 ft. The building will contain two electric elevators and will be lighted by electricity. There will be steam heat and all modern improvements, including ventilation system and a sprinkling system. The operation will represent an expenditure of $400,000.

NEW YORK, N. Y.—Bids are asked by John W. Brannan, Pres. Bd. Trustees Bellevue and Allied Hospitals Dept., until 3 p. m., Dec. 22, for all the labor and materials required for the furnishing and setting of the equipment in the pathological department and male dormitory of the new Bellevue Hospital, situated on First Ave. and bounded by 26th and 29th Sts., Boro. of Manhattan.

The heirs of the Marshall Field Estate have had tentative plans drawn for a 16-story store and office building for the easterly block front on Fifth Ave., between 30th and 31st Sts. The site has a frontage of 197 ft. on the avenue, 164 ft. on 30th St. and 200 ft. on 31st St. The building to be erected and the site represent an investment of $7,000,000.

Schwartz & Gross, Archs., 347 Fifth Ave., advise us that they are taking estimates for interior finish, principally, for two brick and stone 6-story apartments at Broadway and 164th St. Each building will cost $225,000.

Plans have been filed by Cocker & Martin Cooke, Archs., 2010 Fifth Ave., for a 5-story brick and stone tenement, 72 × 88 ft., to cost $75,000. The building will be erected at 161st St., 100 ft. east of Broadway, for Kuhn & Lawson, 508 West 142d St.

NEW YORK, N. Y.—Bids are asked until 11 a. m., Dec. 30, by Bird S. Coler, Pres. Boro. of Brooklyn, for furnishing all the labor and material required to erect three shafts and skylights in roof of Hall of Records, Boro. of Brooklyn.

Bids are asked until 11 a. m., Dec. 28, by C. B. J. Snyder, Supt. of School Bldgs., for alterations, repairs, etc., at Erasmus Hall High School and Public Schools Nos. 6, 16, 17, 19, 23, 31, 33, 34, 39, 51, 59, 71, 78, 90, 95, 98, 99, 100, 100 Annex, 101, 102, 103, 105, 107, 122, 124, 128, 139 and 142, Boro. of Brooklyn; for alterations, etc., in mechanical laboratory of Manual Training High School, on Seventh Ave., between Fourth and Fifth Sts., Boro. of Brooklyn.

INDUSTRY, N. Y.—We are officially advised that bids were received by Miss Laura E. Aldridge, Pres. Bd. of Mgrs. of the New State Agricultural and Industrial School, on Dec. 8, for the construction complete, including heating, plumbing and electric work, of an addition to industrial building, Hospital for Contagious Diseases, four cottages for boys and five cottages for employees. The bids were in excess of the appropriation. Franklin B. Ware, Capitol, Albany, is State Arch.

WATERTOWN, N. Y.—An 8-story fireproof bank and office building is to be erected at the corner of Washington and Stone St., by the National Bank & Loan Co., George C. Sherman, Pres.

PHILADELPHIA, PA.—We are officially advised that Albert J. Sanders, Land Title Bldg., has awarded contract to CHARLES W. DENNY, 1330 Arch St., Philadelphia, for the erection of building at 1926 to 1932 Arch St. for the Gregg Carriage Co. Including the cost of the ground and the building, work upon which will be started at once, the new structure will involve an expenditure of about $100,000. The new building will be four stories high, of slow-burning construction, with a front of brick and terra-cotta. It will have a frontage of 52 ft. on Arch St. and a depth of 150 ft., and will contain 40,000 ft. of floor space, extending to Cuthbert St. It was planned by Henry E. DeHoff.

Estimates on the addition to be built to the Union League club house will be asked from builders shortly before Jan. 1. The plans for the building are being prepared by Horace Trumbauer, Arch., Land Title Bldg. Work on the addition will be begun as soon as the contract can be made. Cost, $600,000.

Plans for the building to be erected by the Curtis Publishing Co., at the corner of Sixth and Walnut Sts., will be completed before the close of the present year. Work on the building is expected to begin early next spring. Noted on Nov. 26.

The Bureau of Yards and Docks, Navy Department, has awarded the contract for making alterations to the Naval Hospital at Philadelphia, Pa., to EDWARD FAY & SON, Philadelphia, Pa., at their bid of $156,440.

HAZLETON, PA.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded to the CARLUCCI STONE CO., Scranton, Pa., contract for the construction of the post-office at Hazleton, Pa., at $47,000. Time, Dec. 1, 1909.

FORT HOWARD (Baltimore post-office), MD.—Bids are asked until 3.30 p. m., Dec. 31, for the construction of one barrack building and two double sets of N. C. O. quarters, and the plumbing, heating and electric wiring for each building.

BALTIMORE, MD.—The Terminal Warehouse Co. has awarded to J. HENRY MILLER, 110 Dover St., the contract for building an addition to its warehouses at Monument, Constitution and Front Sts., known as the Monument St. Stores, including the power-house on Front St. The total cost of the plant will exceed $200,000. The structure was designed by Owens & Sisco, Archs., Continental Trust Bldg., with Charles L. Reeder, Consult. Engr., Equitable Bldg., Baltimore.

WASHINGTON, D. C.—Bids are asked until 11 a. m., Jan. 9, by R. C. Hollyday, Ch. Bureau of Yards and Docks, Navy Dept., Washington, D. C., for extensions to galleries, Building No. 102, U. S. Navy Yard, Washington. Specifications are on file at the office of Engineering News, New York.

MOUNT WEATHER (Washington, D. C., post-office), VA.—Bids are asked until noon, Dec. 22, by James Wilson, Secy. U. S. Dept. of Agriculture, for the completion of an unfinished 3-story and cellar building for the Weather Bureau, U. S. Dept. of Agriculture, at Mount Weather, Va.

*WASHINGTON, D. C.—Bids are asked until noon, Dec. 21, by the Commissioners of the District of Columbia for equipping an auxiliary water system and fire protection for the Home of the Aged and Infirm, subdivisions of Bellevue and Blue Plains, D. C.

SPRINGFIELD, GA.—The contract for erecting court-house has been awarded to F. P. HEIFNER, 221 Gordon St., Atlanta. Estimated cost, $220,000. H. W. Witcover, Savannah, Ga., is Arch.

JACKSON, MISS.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded to H. A. BISHOP, 218 La Salle St., Chicago, contract for the construction of the Jackson, Miss., post-office, at $40,675. Time to complete, June 30, 1910.

NEW ORLEANS, LA.—The City and the Texas & Pacific Ry. Co., L. S. Thorne, Gen. Mgr., Dallas, Tex., have agreed upon a plan for erection of proposed union depot in New Orleans. It is proposed that the railroad company erect the building, which is to revert to the city, cost to be paid in rentals. Cost, about $300,000.

COLUMBUS, OHIO.—We are officially advised that bids were received by the Board of Trustees, the Ohio State University, on Dec. 9, for the erection of a students' building at the Ohio State University, in accordance with plans and specifications prepared by George S. Mills, Ohio Bldg., Toledo,

Ohio. The contract has been let to GEORGE ABERNATHY, of Columbus. The building will be constructed of brick, will be 60 x 128 ft., three stories with basement, and will cost $70,000.

CINCINNATI, OHIO.—A club house for the Woman's Club is to be located in Oak St., near Winslow, Walnut Hills. It is to be built of brick, in the colonial style. It will rest upon a terrace. Construction is to begin as soon as all details are completed. The cost of the building is estimated at $50,000. Mrs. Henry Yergason is interested.

COLUMBUS, OHIO.—Bids are asked by the Trustees of the Ohio Institution for Feeble-Minded Youth, Columbus, until noon, Dec. 18, for furnishing the materials and performing the labor necessary to erect complete a barn at the Ohio Institution. Dr. E. J. Emerick is Secy. Bd.; Frank L. Packard, Columbus, is Arch.

CLEVELAND, OHIO.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract for the installation of an elevator plant in the Cleveland post-office to the OTIS ELEVATOR CO., 17 Battery Place, New York. The contract for the interior finish of the same building has been placed with JOHN GILL & SONS, Cleveland, Ohio, at $794,836. Time to complete, June 15, 1910.

*WARREN, OHIO.—Bids are asked until 3 p. m., Jan. 12, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. post-office at Warren, Ohio.

ANDERSON, IND.—The Commissioners of Madison County are contemplating building a jail and jailer's residence. Estimated cost, $100,000.

INDIANAPOLIS, IND.—The Trustees of the Winona Technical School have ordered plans for the erection of a $200,000 Hotel Employers' Training School building. W. D. Allison is Chn. of Bd.

DETROIT, MICH.—We are officialy advised that George W. Graves, Arch., Cleveland Bldg., has prepared plans for a 3-story family hotel and club house, 110 x 180 ft., to cost $60,000; equipment, $15,000. There will be three buildings and estimates will be received about June, 1909.

CHICAGO, ILL.—A veterinary college is to be erected at the stockyards at a cost of $250,000. Arthur Leonard, Vice-Pres. and Gen. Mgr. of the Union Stockyards & Transit Co., and a number of packers are the principal promoters. The college will be affiliated with the University of Illinois, which has made an appropriation of $35,000 to maintain the school. Ground for the institution has been secured at Halstead and 43d Sts., under a 99-year lease from the stockyards company at a nominal rental. The buildings will be four stories high and will have a ground floor auditorium seating 900 persons.

A building is to be erected on the property at 266 and 268 Wabash Ave. at a cost of not less than $150,000 by the Rudolph Wurlitzer Co., lessees, 266 Wabash Ave.

Officials of the WOODBURY GRANITE CO., of Hardwick, Vt., announce that that company has secured the contract for furnishing the granite to be used in the construction of the city hall in Chicago. The contract calls for 250,000 cu. ft. of gray granite and is said to amount to about $1,000,000. It is expected that a year will be required for quarrying and cutting the blocks of stone.

A 6-story building is to be erected at the corner of Adams and Clinton Sts. The building is to be built by Adeline F. Sharpe for the Western Newspaper Union. The lot is 120 x 128 ft., and the total amount of the investment in ground and building will reach $300,000. The deal was negotiated by the Bowes Investment Co., Stock Exchange Bldg. Estimated cost of building, $170,000.

The location has been decided upon for the first dormitory to be built by the Y. M. C. A. It will be built on the property adjoining the Ravenswood Y. M. C. A. building and will cost $75,000. The newly acquired land is west of the Ravenswood building, at Wilson and Hermitage Aves. It is 50 x 150 ft. The building will be erected soon on the same plan as the present dormitory at 542 Monroe St., and will accommodate 175 men. L. Wilbur Messer is Gen. Secy.

OAK PARK, ILL.—Bids were received by the Board of Cook County Commissioners, at office of William McLaren, Supt. of Public Service, Court-House, Chicago, on Dec. 7 (extension of time), for the erection of the county infirmary at Oak Forest. William Busse is Pres.; Holabeid & Roche, Monadnock Block, are Archs. All the proposals were rejected. The lowest bid received for construction of the infirmary was made by the Thompson-Starrett Co. at $1,898,358.

ST. PAUL, MINN.—Bids are asked by E. L. Masqueray, Arch., Dispatch Bldg., until Jan. 2, for the construction of a pressed brick and cut stone fireproof church for the Church of St. Louis (Roman Catholic), at Tenth and Cedar Sts. It will have electric lighting, steam heating, pastor's residence (brick), marble and tile work, altars and seating capacity for 1,000. Cost, $60,000.

IOLA, KAN.—The DIETER & WENZEL CONSTRUCTION CO., of Wichita, Kan., has the contract for the construction of the Iola public building, at $50,559, plus for alternate B $600, alternate C $213, and for structural sanitary glass $800. Time, Dec. 1, 1909. Bids were received on Nov. 16 and a complete list was given in issue of Nov. 19.

*FORT MEADE, S. DAK.—Bids are asked by Capt. L. C. Scherer, Q. M., until 10 a. m., Jan. 18, for constructing a hay shed.

ST. LOUIS, MO.—The Building Committee of the Board of Education on Dec. 4 received bids for the Humboldt School and other improvements to school property. The lowest of 13 bidders for the Humboldt School was Wall Bros., $176,827. There were 13 bids for the addition to the Pestalozzi School, and the lowest was that of Fred Boeke, for $89,850.

The contract for the Soulard Branch Library building, to be located at the corner of Seventh and Soulard Sts., was awarded on Dec. 12 to J. W. WILSON & SON, Odd Fellows' Building, for $50,949. Sixteen bids were received as follows: J. W. Wilson & Son, $50,949; Hoffman Contracting Co., $50,990; Wall Bros., $51,141; Kellerman Contracting Co., $51,350; E. C. Steininger Construction Co., $51,716; W. M. Sutherland Building & Construction Co., $51,883; P. G. Johnston & Co., $52,000; C. L. Gray Construction Co., $52,867; Harvey & Hall, $52,882; Gillick Bros., $52,975; M. Eyssell Construction Co., $53,591; Murch Bros. Construction Co., $53,823; Wright-Gallagher Construction Co., $54,100; Daniel Evans Construction Co., $55,990; N. Pelligreen Construction Co., $56,245; P. J. Monihan, $58,426. Hellmuth & Spiering, 721 Olive St., are Archs.

The sixth branch of the Public Library is to be built at 14th and Farrar Sts. The plans are being prepared by Mariner & Le Beaume, Archs., 721 Olive St., and the contract probably will be awarded in February.

NEVADA, MO.—The contract with J. A. DALY, of Nevada, Mo., for the construction of the Nevada public building has been increased to $60,837 for betterments. Time to complete, Oct. 31, 1909.

ALBUQUERQUE, N. MEX.—The Masonic societies will erect a building on property owned by the Order at Third St. and Copper Ave. It will be four stories and basement, 100 x 100 ft. in size, and will cost at least $50,000. The ground floor will be used for business purposes and the upper three floors will be devoted exclusively to Masonic purposes.

HOUSTON, TEX.—The South Texas National Bank is having plans prepared by C. B. Gill & Co., Kirby Bldg., Dallas, Tex., for a bank building, two stories and basement, of Grecian style, with front of Georgia marble. Cost, about $100,000.

STILLWATER, OKLA.—Bids are asked until noon, Jan. 8, by W. A. Etherton, Stillwater, for the erection of a boys' dormitory for the Oklahoma Agricultural and Mechanical College, Stillwater.

SPOKANE, WASH.—The Spokane Sash & Door Factory contemplates erection of an office building on Sprague Ave., to cost about $70,000. The structure will be a 4-story brick building, with walls heavy enough for three additional stories.

A 6-story building, costing about $100,000 is planned by the local lodge of the Knights of Pythias. The exact location has not been definitely decided upon.

Washington Water Power Co., Spokane, Wash., it is reported, plans to erect a warehouse and combination passenger depot for the interurban lines at Lincoln and Bridge Sts.

MONROE, WASH.—Plans have been completed for the permanent buildings at the Washington State Reformatory at Monroe. The main building or cell block, will be 64 x 684 ft., and of a height sufficient to contain four tiers of cells. It will have a capacity of 640 cells in all. The necessary buildings will cost about $450,000.

SEATTLE, WASH.—D. F. Coblentz has obtained a permit to erect a 6-story brick business block at 201 Second Ave. The building is to have a ground space of 60 x 108 ft. and will cost approximately $60,000. W. P. White, Washington Bldg., is Arch.

SAN FRANCISCO, CAL.—Contract has been let by the Union Sq. Improvement Co. to P. J. WALKER, Monadnock Bldg., for all work of repairing and altering the steel frame Class A building formerly owned by the Spring Valley Water Co. The amount of the contract price is $212,500. The size of the building is 137.6 x 137.6 ft. Work will begin at once. The building is situated at the corner of Geary and Stockton Sts.

A committee from the San Francisco Polytechnic High School, consisting of the principal, Walter N. Bush, and Walter S. Carniglia, Arthur L. Jordan and Miss Marea Van Vleck, have applied to the Board of Education for better quarters. A resolution was passed by the Board that a request be made to the Board of Public Works that Newton A. Thorp, City Arch., proceed to prepare plans and specifications at once for the construction of a new Polytechnic High School to cost not less than $300,000.

The design for the new St. Luke's Church (Protestant Episcopal), which is to replace the old stone edifice at the southeast corner of Clay and Van Ness Ave., has been completed by the Architects, Sexton & Nicholson, Chronicle Bldg., and approved by Bishop W. F. Nichols and the vestrymen. Estimated cost, $50,000.

SAN FRANCISCO, CAL.—The firm of Hale Bros. has taken a lease on the lot at the corner of Market and Fifth Sts., and made arrangements, under an agreement with the owner of the property, to erect a department store covering the entire lot. The cost of the proposed building must not be less than $300,000.

It is stated that Irving C. Ackerman, Vice-Pres. of the Chutes, Tenth Ave. and Fulton St., is interested in construction of an auditorium on the block bounded by Fillmore, Webster, Eddy and Turk Sts. Estimated cost, $200,000.

LOS ANGELES, CAL.—Hudson & Munsell, Archs., Stimson Bldg., have been instructed by the Board of Supervisors to prepare plans for three buildings to be erected on the grounds of the County Hospital, on Mission Road. They will comprise an administration building, a medical ward and a tuberculosis ward. The proposed improvement will cost about $180,000.

I. I. Dehail has let contract to F. O. ENGSTRUM CO., Temple and Spring Sts., for erection of a 6-story and basement building to be used as a hotel at First and San Pedro Sts. Cost will be $46,733. Train & Williams, 254 South Broadway, are Archs.

Marco A. Hellman, Vice-Pres. of the Merchants' National Bank, is planning to erect a magnificent home at a cost of approximately $75,000. The property has a frontage 145 ft. on Wilshire Boulevard and 235 ft. on Catalina St.

BOISE, IDAHO.—The Boise & Interurban Railroad, Boise, will build a freight house at Twelfth and Front Sts. A substantial foundation for the building will be constructed to permit of enlarging the structure later. Tracks will be built into the building, permitting of loading and unloading under cover. Plans are being prepared for the company's passenger depot and office buildings at Seventh and Bannock Sts. It is expected that work on this building will be begun next summer. This building ultimately will cost at least $50,000.

MONTREAL, QUE.—Bids are asked by Alphonse Gagnon, Secy. of the Provincial Dept. of Public Works, Quebec, until Dec. 23, for the erection of a jail for the District of Montreal. Plans and specifications may be seen at the Department and at the offices of Marchand & Brassard, Archs., 164 St. James St., Montreal, Que.

WINNIPEG, MAN.—The T. Eaton Co. has decided to erect a 100 x 133-ft. warehouse in connection with the department store. Work will be commenced soon. A. A. Gilroy is Local Mgr.

WINNIPEG, MAN.—W. Wallace Blair, Arch., Northern Bank Bldg., advises us that he has prepared plans for an apartment block to be erected here for Dr. R. I. Mattice, Canada Life Bldg., Cost, $175,000. The foundations will be ready in the spring and contracts will be let for the building about March 1. The building will be 130 x 100 ft., with five stories and basement, and partly fireproof.

CALGARY, ALTA.—Bids are asked by Napoleon Tessier, Secy. of the Dept. of Public Works, Ottawa, Ont., until 4 p. m., Dec. 21, for fittings for the public building to be erected here. Plans and specifications may be seen at the Department and at the office of J. J. O'Gara, Res. Engr., Calgary.

WATER SUPPLY—IRRIGATION.

(denotes that this work is advertised in Engineering News.)*

FORT McKINLEY (Portland post-office), ME.—Bids will be received until Dec. 19 by Capt. F. J. Morrow, Q. M., U. S. A., Portland, for sinking deep wells at Fort McKinley.

ANDOVER, ME.—We are officially advised that CHARLES N. TAYLOR, of Wellesley, Mass., has been awarded the contract for furnishing material and constructing a water system for the Andover Water Co., Andover. This system consists of 2½ miles of 8-in. and 1½ miles of 6-in. pipe, and a concrete dam. Estimated cost, $27,000. CHARLES MILLAR & SON CO., have received the contract for furnishing the pipe.

FORT GETTY, R. I.—Bids were opened on Dec. 7 as follows at the office of Capt. Willis C. Metcalf, Q. M., U. S. A., Newport, for a water system: Antony Cefalo, 220 Devonshire St., Boston, Mass., $4,575; McCay Engineering Co., Baltimore, Md., $7,106; F. H. Cowin Co., Boston, Mass., $7,532; Joseph P. Cotton, Newport, $5,723; M. A. McCormick, Newport, $7,894; Philip F. Conroy, Newport, $9,346; P. J. Murphy Co., Newport, $5,813; Thomas B. Connolly, Newport, $6,177; Darling & Slade, $6,900; J. F. Johnston Co., Fall River, Mass., $7,272.

MANCHESTER, MASS.—We are officially advised that CHARLES N. TAYLOR, of Wellesley, Mass., has been awarded the contract by the Water Commissioners for constructing a screen chamber and laying 16-in. intake pipe at Gravel Pond.

NEW YORK, N. Y.—Bids will be received until 2 p. m., Dec. 21, by John H. O'Brien, Comr. of Water Supply, Gas and Electricity, for furnishing and laying water mains in 16th, 17th, 18th, 19th and 20th Sts. and Irving Pl., Borough of Manhattan.

BUFFALO, N. Y.—Bids will be received until Dec. 23 by Francis G. Ward, Comr. Pub. Wks., for furnishing material and erecting a steam main for the boilers in the north boiler-house and connecting the new main to the present lines in the engine room.

*HADDONFIELD, N. J.—Bids were opened on Dec. 1 by the Borough Council for the construction of municipal water-works here. The Council was enjoined from acting on bids for the present. Allen Clymer is Boro. Clk.

PENBROOK, PA.—The Extension Water Co., of Penbrook, has been incorporated with a capital of $5,000, to supply water from Swatara Creek to Penbrook. The incorporators are: D. Gring, of Newport; S. F. Dunkle and G. C. Cochenauer, Harrisburg, Pa.

WASHINGTON, D. C.—Bids will be received by the Commissioners of District of Columbia until Dec. 21 for an auxiliary water system and fire protection for the Home for Aged and Infirm, subdivisions of Bellevue and Blue Plains, District of Columbia.

William T. Belt, Ch. Fire Dept., in his annual report to the District Commissioners has recommended the installation of a high-pressure water system for fire protection.

ORANGE, VA.—D. G. Adelsberger, of Baltimore, Md., is preparing plans for the construction of water-works here.

COVINGTON, GA.—The contract for the construction of water-works here has been awarded by the city to the GENERAL CONTRACT & CONSTRUCTION CO., Atlanta, Ga.

PENSACOLA, FLA.—The D'OLIER ENGINEERING CO., 121 South Eleventh St., Philadelphia, Pa., has secured the contract for a water system at the navy yard, Pensacola, at $9,726. Bids were opened on Nov. 21. List of bidders noted on Nov. 26.

CLARKSDALE, MISS.—The city has rejected all bids for the construction of reservoir, water mains, hydrants, etc., and will undertake the work under the supervision of Walter G. Kirkpatrick, Engr. Jackson, Miss. M. W. Purnell is City Clk.

DELHI, LA.—The city contemplates constructing a water-works and electric light plant.

LOUISVILLE, KY.—Bids will be received by the Board of Public Works until [illegible] for erecting 63 fire hydrants. Estimated cost, $7,800. John Chambers is Ch. Engr. Dept. Pub. Wks.

MINERVA, OHIO.—Bids will be received until Jan. 4 by the Board of Affairs, L. E. Weber, Secy., for a bank and tower of 100,000 U. S. gallon city.

EAST LIVERPOOL, OHIO.—W. Hill, of Cincinnati, Ohio, has prepared plans for the proposed filtration plant. will soon be asked. Estimated cost, $ J. C. Kelly, City Engr., will have vision of the work. Willis Davidson is Audr.

YOUNGSTOWN, OHIO.—Bids will be received until noon, Dec. 28, by the asked Service for furnishing about Public ters. W. H. McMillin is Clk. ater me-

SHAWNEE, OHIO.—Bids will be received by the city for furnishing been re- c.-i. water pipe, etc., as follows: ed Riche ards Plumbing Co., Columbus; S. Con struction Co., Columbus; (c) ing Con struction Co., Leasdale, Pa.: ft. ex cavation, (a) 27½ cts., (b) 18 cts 25 cts.; 2,682 ft. 4-in. pipe, (a) 44 cts. 38 cts. (c) 58 cts.; 4,450 ft. 6-in. pipe, 1½ cts. (b) 54 cts., (c) 68 cts.; 2,300 ft. in. pipe, (a) 81½ cts., (b) 75 cts., (c) 87 2.8 tons specials, (a) $118, (b) $85, (c) $ 24 4-in. valves, (a) $15.05, (b) $12.50, 12; nine 6-in. valves, (a) $20.80, (b) $17 (c) $16; seven 8-in. valves, (a) $29.20, 827, (c) $20; 22 hydrants, (a) $30.75, 27, (c) $35; 10 cu. yds. concrete, (a) $1 (b) 86; (c) $10. Total, (a) $10,315, (b) 358, (c) $10,699. Bradbury & Shute, Columbus, Ohio, are Engrs.

JEFFERSONVILLE, IND.—The Board of Managers of the Indiana Reformatory has recommended the installation of a water system at the institution. Estimated cost, $20,000.

WOLCOTTVILLE, IND.—RICKETT BROS., of Auburn, Ind., have been awarded the contract for installing water-works here. Work has begun.

GARRETT, IND.—The receiver of the Toledo & Chicago Interurban Ry. Co. has awarded the contract to construct a concrete water course along its tracks near here to the NATIONAL CONCRETE CO., at $7,150.

WILTON, WIS.—O. Claussen, Consult. Engr., German-American Bank Bldg., St. Paul, Minn, has awarded the contract to SWEENEY BROS., Reedsburg, Wis., for the construction of the water-works here, at $9,61[illegible].

COUNCIL BLUFFS, IOWA.—Plans are being prepared by Burns & McDonnell, Consult. Engrs., Scarritt Bldg., Kansas City, Mo., for the construction of municipal water-works here. The water supply will be taken from the Missouri River, using sedimentation basins and filters for purification.

SABETHA, KAN.—Burns & McDonnell are preparing plans for the construction of water-works here. Estimated cost, $75,000.

BELLE FOURCHE, S. DAK.—Hayes Bros., who have the contract for the construction of the storage reservoir of the Belle Fourche irrigation project, have sub-let portions of the work, as follows:

A. F. BURKE & SONS and HICKEY BROS., Times Bldg., St. Louis, Mo., were awarded the contract for paving the face of the dam with concrete blocks, and for putting on the screened and unscreened gravel under the concrete blocks, and the PEOPLES CONSTRUCTION CO., of Davenport, Iowa, for about $60,000 worth of concrete work. This work includes the concrete facing on the down-stream face of the dam, the footing walls on the upstream face of the dam, and also the concrete lining of the waste channel.

CHEYENNE, WYO.—The Wyoming Central Irrigation Co., Jay Morton, Pres., Chicago, Ill., has filed with C. T. Johnson, State Engr., Cheyenne, plans for an irrigation canal, 132 ft. wide at top, 60 ft. wide at bottom and 45 miles in length. Work on the main canal will begin next spring.

MINCO, OKLA.—Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are preparing plans and specifications for municipal water-works and lighting plant for Minco. Estimated cost, approximately $30,000.

ADA, OKLA.—The city has voted in favor of issuing $81,500 of bonds for extending water-works, constructing sanitary and storm sewers, and other improvements.

TONKAWA, OKLA.—Plans are being prepared by Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., for the construction of water-works here. Estimated cost, $35,000.

ARROYOHONDO, N. MEX.—Bids are asked by the Board of Trustees of the Santa Fe Irrigation & Improvement Co., 23 Laughlin Block, Santa Fe, N. Mex., until 2 p. m., Dec. 19, for constructing a dam and reservoir, known as Arroyohondo dam project No. 1. Plans and specifications may be seen at the office of Daniel J. Spiane, 1101 Rector Bldg., Chicago, Ill.

*WENATCHEE, WASH.—The Council on Dec. 1 awarded the contract to BALL & McNERNEY, Wenatchee, for extensions and additions to the water-works. List of bidders noted on Dec. 10.

The ELLIOTT BAY IRON WORKS, Seattle, secured the contract for the installation of the pump at $8,790.

GRIDLEY, CAL.—Contracts for supplies for the new water system at Gridley have been awarded to the PACIFIC COAST SUPPLY CO., the DUNHAM, CARIGAN & HAYDEN CO. and the UNITED STATES CAST IRON PINE CO. Total cost, $8,742.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded the contract for the construction of reinforced-concrete fire cisterns at the crossings of 15th and Kansas Sts., Eighth and Townsend Sts., Ala-

bama St... Procita Ave. and 20th and Connecti... s., to J. A. DOWLING, Russ Bldg., S... ancisco, at $18,540. Marsden Manson ... y Engr.

SALINA...TAH.—Richard R. Lyman, of Salt Lak... y, is preparing plans for the construct... water-works. Estimated cost, about $1...

MACLE...ALTA.—The ratepayers of this city hav... d in favor of spending $55,000 for addi... to the water-works and electric lighting ... ns.

SEWERAGE.

(denotes that this work is advertised in Engineering News.)*

WILL...STIC, CONN.—See item under Streets ... Roads.

LONG...AND CITY (L. I.), N. Y.—Bids are ask... till 11 a. m., Dec. 23, by Lawrence G... r, Pres. Boro of Queens, for constru... sewers, temporary sewer and tempora... atch basins and appurtenances in various ... ts.

AUBU... N. Y.—The Common Council on Dec. 4 ... arded the contract to PETER BYRNE ... for the construction of the Fulton St. sewe...

WAVERLY, N. Y.—The Board of Village Trustees is considering constructing a sewerage system and sewage disposal plant. Proctor & Potts are Engrs., New York.

WARR... N. Y.—Wylie Maitland, Asst. Boro. Engr., is making surveys for the construction of a trunk sewer to extend from the east side to the west end of the city limits.

BROOKLYN, N. Y.—Bids were received on Dec. 9 as follows by Bird S. Coler, Boro. Pres., for regulating, grading and paving with granite on a concrete foundation the roadway of West Ninth St., from Hicks St. to Henry St., together with all work incidental thereto: McCluskey & Carroll, 510 LaFayette St., Brooklyn, $5,151; Norton Gorman Co., 304 Douglas St., Brooklyn, $5,-332; P. W. Grace, 44 Court St., Brooklyn, $5,497; M. F. Hickey, Second Ave., Brooklyn, $5,422.

NEW YORK, N. Y.—The following bids were received on Dec. 8 by George Cromwell, Pres. Boro. of Richmond, for furnishing all the labor and materials required for constructing a temporary combined sewer and appurtenances in First Ave. between Westervelt Ave. and Jersey St., together with all work incidental thereto: Bonnaci & Vincelli Contracting Co., DeGraw Ave., Brooklyn, $4,957; John E. Donovan, 25 Mgstar Road, S. I., $6,017; Joseph Johnson's Sons, 193 Broadway, $6,550; W. J. Quinlan, Port Richmond, S. I., $5,061; James D. Sullivan, Tyson, S. I., $6,145.

The following bids were received at the same time for furnishing all the labor and materials required for constructing a temporary combined sewer and appurtenances in St. Marys Ave. from Tompkins Ave. to Reynolds St., together with all work incidental thereto: William J. Quinlan, Port Richmond, S. I., $12,117; Bonnaci & Vincelli Contracting Co., DeGraw Ave., Brooklyn, $12,-708; John E. Donovan, 25 Mgstar Road, S. I., $18,739; Joseph Johnson's Sons, 193 Broadway, S. I., $15,165.

At the same time and place, bids were received as follows for furnishing all the labor and materials required for constructing a temporary sanitary sewer and appurtenances in Richmond Turnpike, from the Little Clove Road to a point about 100 ft. west of Manor Road, together with all work incidental thereto: Bonnaci & Vincelli Contracting Co., DeGraw Ave., Brooklyn, $5,021; John E. Donovan, 25 Mgstar Road, S. I., $6,929; James D. Sullivan, Tyson, S. I., $7,564; W. J. Quinlan, Port Richmond, S. I., $5,744; C. Vanderbilt, 14 Elizabeth St. S. I., $7,321.

NEW YORK, N. Y.—Bids were received as follows on Dec. 7, by John F. Ahearn, Pres. Boro. of Manhattan, for (a) furnishing all the labor and materials required for sewer and appurtenances in West 168th St., between Fort Washington Ave. and Broadway; (b) furnishing all the labor and material required for sewer and appurtenances in West 169th St., between Broadway and Fort Washington Ave.; (c) furnishing all the labor and material required for sewers and appurtenances in Broadway, both sides, between Isham and Emerson Sts.; (d) furnishing all the labor and material required for sewer and appurtenances in Emerson St., between Vermilyea Ave. and Cooper St., and in Broadway, both sides, between Emerson St. and Summit South: (a) Michael Marrone, 414 East 116th St., New York, $7,851; P. J. Brennan, 624 Madison Ave., New York, $11,-110; Joseph Moore, $10,099; Hanover Contracting Co., 215 West 125th St., New York, $8,842; John Slatterly, 368 Park Ave., New York, $8,306; Bart Dunn, 444 East 68th St., New York, $7,867; Joseph J. Haiduvan, 69 East 177th St., New York, $9,037; William Gleason, $8,928. (b) John Slatterly, $7,776; Hanover Contracting Co., $8,591; P. J. Brennan, $8,182; Bart Dunn, $7,980; Joseph Moore, $9,719; Anthony Kelley, $8,517; William Gleason, $8,346; J. J. Haiduven, $7,865. (c) John Slatterly, $3,716; Hanover Contracting Co., $4,470; Bart Dunn, $5,031; P. J. Brennan, $5,803; Joseph J. Haiduven, $4,116. (d) Bart Dunn, $12,802; John Slatterly, $13,267; William Gleason, $14,747; P. J. Brennan, $13,573; Hanover Contracting Co., $14,930; Joseph Burns, $20,281; Michael Marrone, $13,452.

NEW YORK, N. Y.—Bids are asked until 11 a. m., Dec. 24, by Louis F. Haffen, Pres. Boro. of The Bronx, for constructing sewers and appurtenances in Grand Boulevard and Concourse (both sides), between East 104th and East 200th Sts.

COALDALE, PA.—The Town Council has awarded the contract for the construction of the sewerage system to ANDREW BRESLIN, of Summit Hill, at about $26,000.

DANVILLE, PA.—Bids are asked by the Board of Trustees until noon, Jan. 14, for constructing a new sanitary sewer system for the State Hospital for the Insane consisting of about 7,500 ft. of terra cotta pipe, sizes from 8 to 15 ins., with manholes, flush tanks, etc.; also for constructing a sewage disposal plant, consisting of concrete sedimentation tanks, sprinkling and sand filters, 12-in. c.-i. force main and the electrically-driven and automatically-controlled centrifugal sewage pump, etc. Dr. H. B. Meredith is Supt.

HARRISBURG, PA.—M. B. Cowden, City Engr., has estimated the cost of the Market St. sewer at $35,000.

POLK, PA.—Bids are asked by the Board of Trustees of the State Institution for the Feeble-Minded of Western Pennsylvania until 2 p. m., Jan. 13, for the construction of a sewage disposal plant. John A. Wiley is Secy. Bd.

CLINTON, S. C.—The Business League contemplates having a survey made for the construction of sewerage system. J. F. Jacobs is Chn. Special Committee on Sewerage.

MOBILE, ALA.—The Mobile Electric Co. has applied for a franchise to construct a pipe line and sewer from its plant at St. Louis and Royal Sts. to the river, and to erect and maintain a pump-house at the foot of St. Anthony St.

OXFORD, OHIO.—Bids will be received until noon, Dec. 22, by D. P. Beaton, Village Clk., for constructing a sewage disposal plant, consisting of sedimentation tank, filter beds, automatic distributing machinery and controlling house. Riggs & Sherman are Engrs., Toledo, Ohio. Advertised last week.

MARYVILLE, OHIO.—A sanitary sewer system may be installed here by the city. Estimated cost, $75,000.

ALLIANCE, OHIO.—Bids will be received by the Board of Public Service until noon, Dec. 23, for furnishing the material and labor necessary for the construction of lateral sanitary sewers Nos. 102, 103, 104 and 106. C. E. Swearingen is Clk.

DAYTON, OHIO.—GEORGE HECKER, JR., of Dayton, has secured the contract for constructing the Wyoming St. storm sewer at $4,154. Bids were opened on Dec. 4.

COLUMBUS, OHIO.—Bids will be received until Dec. 18 by the Board of Public Service, E. W. Hirsch, Secy., for constructing a sewer in a portion of Mitchell St. and in portions of four alleys.

*HARTWELL, OHIO.—We are officially advised that EVAN EVANS, 1226 Ida St., Cincinnati, Ohio, has been awarded the contract by the Village Council for furnishing the necessary labor and materials for the construction of sewers and for the construction of sewage disposal works here at $18,-498. Bids were opened on Nov. 16. The Riggs & Sherman Co., The Nasby, Toledo, Ohio, are Engrs. Noted on Nov. 26.

PIQUA, OHIO.—The contract for the construction of the storm sewer in East Piqua has been awarded by the Board of Public Service to the BACKUS CONSTRUCTION CO., of Dayton, Ohio, at $5,788. The estimate of the Engineer was $5,827.

MARION, IND.—Bids will be received by the Board of Public Works until 9.30 a. m., Dec. 18, for the construction of a sanitary sewer here. John O. Wilson is Clk. Bd.

INDIANAPOLIS, IND.—MANLEY, O'DONNELL & CO. have secured the contract at $1.69 per lin. ft. for the construction of a sewer in Riley St., and at 74 cts. per lin. ft. for the sewer in 33d St. B. H. Miller is City Engr. Noted Dec. 10.

GLADSTONE, MICH.—H. J. KRUEGLE has secured the contract for constructing a 10-in. sewer in Wisconsin Ave.

GREEN BAY, WIS.—Bids will be received until 2 p. m., Dec. 21 by the Committee on Sewers and Plumbing, Fred. F. Martin, Chn., for 416 ft. of 14-in. pipe sewers in portions of Dousman, East Mason and Emily Sts. and 160 ft. of 48-in. pipe sewers in Fox River.

DAVENPORT, IOWA.—The ROBINSON CONSTRUCTION CO. has been awarded the contract for the work on the 24th St. storm sewer by the Sewer Finance and Water-Works Committee. Four bids were received.

MANHATTAN, KAN.—Plans and specifications are being prepared for a complete system of sanitary sewers and storm sewers for Manhattan. Estimated cost, $75,000.

CARTERVILLE, MO.—The city has decided to extend the sewer system. A. W. Canada is City Engr.

LITTLE ROCK, ARK.—E. A. Kingsley, Supt. Pub. Wks., has estimated the cost of constructing a storm-water sewer system at $10,000. The system will comprise a 36-in. sewer north on Louisiana St. to Arkansas River from Third St., and two 24-in. laterals, each one block long.

FORT WORTH, TEX.—North Fort Worth has voted $50,000 of bonds for the construction of a sewer system. John F. Grant is Mayor.

SEYMOUR, TEX.—The city has voted $12,-000 of bonds for sewer construction.

ADA, OKLA.—See item under Water Supply—Irrigation.

DENVER, COLO.—The Board of Public Works has establish'd four new storm sewer sub-districts in North Denver, work on which will be started in the spring as follows: District No. 2—West 29th Ave., Boulevard F, West 24th Ave. and Lowell Boulevard. Estimated cost, $22,469. District No. 3—West 24th Ave., Boulevard F, West 20th Ave. and Lowell Boulevard. Estimated cost, $21,522. District No. 4—West 25th Ave., Seventh St., West 20th Ave. and Boulevard F. Estimated cost, $26,610. District No. 6—West 20th Ave., Boulevard F, West Colfax and Lowell Boulevard. Estimated cost, $24,-388.

SPOKANE, WASH.—Plans have been prepared by the City Engineer, and will be submitted to the City Council for approval, by the Board of Public Works, for the construction of a sewer system in the Fifth Ward, District No. 3. Estimated cost, $10,-208.

PROVO, UTAH.—The City Council on Dec. 1 adopted the plans of A. F. Parker, Engr., Ogden, Utah, for the construction of a new sewerage system here.

Bids for the construction of sewer extension No. 8 were opened on Dec. 1 and the contract, which calls for 11,000 ft. of work, was awarded to DAVIS & HEUSER, Salt Lake City, Utah, at $15,500. The other bids were: Wheelwright Construction Co., Ogden, $15,757; W. A. Williams Plumbing Co., Provo, $17,571. All bids were under the engineer's estimate.

MACLEOD, ALTA.—The rate payers of this place have voted in favor of expending $35,-000 for the installation of a sewerage system.

GARBAGE DISPOSAL.

(denotes that this work is advertised in Engineering News.)*

BOSTON, MASS.—Guy C. Emerson, Supt. of Streets, on Dec. 12 awarded contracts for the removal of snow from the streets north of Dover St. The award for District No. 1 was made to J. C. COLEMAN & SON, 41 Ritchie St., Boston, at 38 cts. a cu. yd., and for Districts Nos. 2, 3, 4 and 5 to CHARLES J. JACOBS CO., 107 Terrace St., Boston, at 30, 35, and 50 cts. per cu. yd. Under the terms of the contracts the contractors will be allowed to dump clean snow in the tide water, but will be compelled to provide dumps for the other snow and ice.

FORT SLOCUM (New Rochelle post-office), N. Y.—Plans and specifications are on file at the office of Engineering News, New York, for the construction of a garbage crematory here. Bids are asked until Jan. 6.

PORTSMOUTH, VA.—The city will establish an incinerator plant to cremate all garbage and refuse. Estimated cost, $20,000. The plant will have 25 tons capacity, building to be of ordinary construction. E. B. Hawks, Chn. St. Com., will ask for bids about Dec. 17.

STREETS AND ROADS.

(denotes that this work is advertised in Engineering News.)*

WILLIMANTIC, CONN.—The city on Dec. 7 voted the following appropriations: Street Department, $11,000; Street Department for resurfacing Main St., $5,000; sewer construction, $8,000; maintaining sewers, $1,200; new streets, $1,000; sidewalks, $3,000.

HARTFORD, CONN.—Bids for the construction of state road work were received at the office of the State Highway Commissioner on Dec. 9, as follows: Town of East Lyme, 9,850 lin. ft., including three 15-in., two 18-in. and one 24-in. tile culverts: (a) gravel, (b) gravel-telford, (c) macadam, (d) macadam-telford, (e) railing. John F. Gill Co., Winter Hill Station, Boston, Mass., (a) $1.58, (b) $1.98, (c) $2.19, (d) $2.59, (e) 34 cts.; Amos Bridges' Sons, Hazardville, Conn., (a) $1.78, (b) $2.38, (c) $2.06, (d) $2.46, (e) 40 cts.; Lane Construction Corporation, Meriden, (c) $1.96, (d) $2.25, (e) 40 cts.; T. H. Gill Co., Boston, Mass., (a) $1.51, (b) $1.90, (c) $1.67, (d) $2.07, (e) 30 cts.; B. D. Pierce, Jr., Co., Bridgeport, (a) $2.18, (b) $2.78, (c) $2.83, (d) $3.48, (e) 50 cts.; A. Brazos & Sons, Middletown, (a) $3.74, (b) $4.20. Also 3,750 lin. ft. gravel-telford on the Niantic turnpike, including two 15-in and one 30-in. tile culverts: J. F. Gill Co., $3.34; Amos Bridges' Sons, $3.47; Lane Construction Corporation, $2.49; Donahue Bros., Middletown, $5.98; A. Vito, Thompson, Conn., $3.11; T. H. Gill Co., $3.70; B. D. Pierce, Jr., Co., $6.14; A. Brazos & Sons, $4.98; O'Neil & Anderson, East Hampton, Conn., $1.33½. Town of Waterford, 5,750 lin. ft. on the Flanders Road—(a) macadam, (b) telford, (c) native stone macadam, (d) native stone telford: J. F. Gill Co., Boston, Mass., (a) $2.24, (b) $2.74, (c) $1.94, (d) $2.48. Arrigoni & Bro., Durham, (a) $1.80, (b) $2.20, (c) $1.40, (d) $1.70; Amos Bridges' Sons, Hazardville, (a) $1.96, (b) $2.40, (c) $1.67, (d) $2.15; Lane Construction Corporation, Meriden, (a) $1.91, (b) $2.08. T. H. Gill Co., Boston, Mass., (a) $1.93, (b) $2.25, (c) $1.67, (d) $2.05. John G. Crane, New London, (a) $1.87, (b) $2.60, (c) $1.58, (d) $2.33. Henry H. Morgan, New London, (a) $2.18½, (b) $2.49½, (c) $1.24, (d) $1.84.

BROOKLYN, N. Y.—Bids are asked until 11 a. m., Dec. 30, by Bird S. Coler, Boro. Pres., for regulating and repairing with granite and asphalt on a concrete foundation the roadways of various streets; also for grading, curbing and laying sidewalks on various streets.

NEW YORK, N. Y.—Bids were received as follows by the Park Board on Dec. 10 for excavating and disposing of earth or other materials, and furnishing in place thereof good garden mold in the parks on Broadway, between 87th and 110th Sts., Borough of Manhattan: William Masterson, 189th St. and Fort Washington Ave., $8,550; William Younge, $11,530; Atlanta Contracting Co., 230 East 42d St., $11,480; P. M. Dorgan, $22,150; P. J. Kane, 735 East 150th St., $12,125; Charles L. Doran, 1015 Walton Ave., $11,800; The New Jersey Co., 11 Broadway, $23,005.

Bids were also received on Dec. 10 by the Park Board for furnishing and setting curb stones and constructing walks of rock asphalt mastic in the addition to Riverside Park at 122d St., Borough of Manhattan, as follows: Atlanta Contracting Co., $5,901; McHarg Barton Co., 165 Broadway, $7,952; Meade & Co., $10,929; Sicilian Asphalt Paving Co., 41 Park Row, $6,945.

NEW YORK, N. Y.—The lowest bid opened on Dec. 1 by Louis F. Haffen, Pres. Boro. of The Bronx, for paving 165th St. and Clay Ave. was submitted by the Barber Asphalt Paving Co., 30 Church St., as follows: 5,420 sq. yds. asphalt block pavement, $1.73; 883 cu. yds. concrete, including mortar bed, $6; 3,125 lin. ft. old curb reset in concrete, 38 cts. Total, $15,862. Other bidders were: Continental Asphalt Paving Co., $15,962; Asphalt Construction Co., $16,746; Hastings Pavement Co., $15,992.

The lowest bids opened on Dec. 1 by Louis F. Haffen, Pres. Boro. of The Bronx, for paving East 179th St, East 139th St. and Jennings St. with asphalt block were submitted by the Asphalt Construction Co., Madison Ave. and 137th St., at $13,426, $8,567 and $5,343, respectively.

NEW YORK, N. Y.—Bids were received as follows on Dec. 7 by John F. Ahearn, Pres. Boro. of Manhattan, (a) for maintaining the asphalt pavement on Eighth Ave. (Central Park West), from 59th St. to 110th St., where the original contract has been abandoned, Borough of Manhattan; (b) for maintaining the asphalt pavement on Third St., from Second Ave. to Lewis St., and Fourth St., from Second Ave. to Lewis St.; (c) for maintaining the asphalt pavement on Broadway, from the north side of Canal St. to 14th St., where the original contracts have been abandoned, Borough of Manhattan; (d) for maintaining the asphalt pavement on Broadway from 14th St. to north side of 23d St., including the space between University Pl., 14th St. and east side of Broadway, and from north side of 25th St. to north side of 42d St., where the original contracts have been abandoned, Borough of Manhattan; (e) for regulating and repaving with wood block pavement on a concrete foundation the roadway of Prince St., from the west side of Broadway to the east side of Wooster st.; (f) for regulating and repaving with wood block pavement on a concrete foundation the roadway of Broome St., from the east side of Broadway to the west side of Centre St.; (g) for regulating and repaving with wood block pavement on a concrete foundation on the roadway of West Third St., from the west side of Mercer St. to the east side of West Broadway; (h) for regulating and repaving with sheet asphalt pavement on a concrete foundation the roadway of 21st St., from the west side of Fifth Ave. to the east side of Sixth Ave.; (i) for regulating and repaving with sheet asphalt pavement on a concrete foundation the roadway of Broome St., from the east side of the Bowery to the west side of Lewis St.: (a) Uvalde Asphalt Paving Co., 1 Broadway, New York, $14,045; Sicilian Asphalt Paving Co., 41 Park Row, New York, $12,425; Vulcanite Asphalt Paving Co., 1170 Broadway, New York, $10,500. (b) Uvalde Asphalt Paving Co., $3,525; Sicilian Asphalt Paving Co., $9,550; Vulcanite Asphalt Paving Co., $7,970. (c) Uvalde Asphalt Paving Co., $31,275; Sicilian Asphalt Paving Co., $25,450. (d) Uvalde Asphalt Paving Co., $7,285; Sicilian Asphalt Paving Co., $7,362. (e) Barber Asphalt Paving Co., 30 Church St., New York, $9,000; U. S. Wood Preserving Co., 29 Broadway, New York, $7,830. (f) Barber Asphalt Paving Co., $11,-920; U. S. Wood Preserving Co., $11,223. (g) Barber Asphalt Paving Co., $9,812; U. S. Wood Preserving Co., $9,647. (h) Barber Asphalt Paving Co., $9,331; Uvalde Asphalt Paving Co., $9,405; Continental Asphalt Paving Co., 79 Wall St., New York, $9,585; Sicilian Asphalt Paving Co., $9,287. (i) Barber Asphalt Paving Co., $43,966; Uvalde Asphalt Paving Co., $43,674; Continental Asphalt Paving Co., $45,908; Sicilian Asphalt Paving Co., $44,592.

NEW YORK, N. Y.—Bids are asked until 3 p. m., Dec. 24, by the Park Board for furnishing and setting new curbstones in the parks on Broadway, between 80th and 95th Sts., Borough of Manhattan; for furnishing and delivering 3,000 cu. yds. of mould on parks in Borough of Manhattan and for furnishing and setting new curbstones in the parks on Broadway, between 95th and 110th Sts., Borough of Manhattan.

LONG ISLAND CITY (L. I.), N. Y.—Contracts for paving, bids opened on Nov. 24 by Lawrence Gresser, Pres. Queens Boro., have been awarded as follows: For asphalt paving on Second Ave., First Ward, to HASTINGS PAVEMENT CO., 25 Broad St., New York, at $35,461; asphalt block on Temple St., CONTINENTAL ASPHALT PAVING CO., 79 Wall St., New York, at $18,345; wood block on Bergen Ave., U. S. WOOD PRESERVING CO., 29 Broadway, New York, at $17,022.

BROOKLYN, N. Y.—Bids are asked by Bird S. Coler, Boro. Pres., until 11 a. m., Dec. 23, for regulating and repaving with asphalt on a concrete foundation the roadway of Fulton St., between Hanover Pl. and Flatbush Ave., and Flatbush Ave., between Fulton St. and Fifth Ave. (both sides), and the east side of Flatbush Ave., between Fifth Ave. and Plaza St., together with all work incidental thereto.

SALEM, N. J.—The following bids were received on Dec. 9 by the Board of Chosen Freeholders for the construction of the gravel road leading from Elmer to the Gloucester County line, a distance of 3.31 miles: J. S. FISLER & SON, Clayton, N. J., $10,973 (awarded contract); John Quinlan, South Amboy, N. J., $14,468; Robert E. Hand, Cape May, N. J., $11,876; Tuft & Lloyd, Salem, N. J., $12,900; George F. Snyder & Co., Philadelphia, Pa., $13,323; Sutton & Corson, Ocean City, N. J., $12,246; Rickey-Swan Co., Trenton, N. J., $18,423. John F. Ayres is Dir.

ROCKVILLE, MD.—The contract will soon be let for the construction of three miles of pike from Kensington to Bradley Lane. Estimated cost, $25,000.

WESTERNPORT, MD.—CHARLES S. JEFFRIES, Frostburg, Md., has been awarded the contract for constructing the Westernport State aid road, 1¼ miles long.

WASHINGTON, D. C.—A bill was introduced in the House of Representatives appropriating $4,000,000 for the construction of a boulevard 100 ft. wide from the District of Columbia to the Gettysburg battlefield, Pennsylvania, via the battlefield at Antietam, Maryland, in memory of Abraham Lincoln. The proposed highway is to be constructed under a committee of five of the United States appointed by the President and to have assistance from the United States Army engineers and road exports of the Agricultural Department.

GRAHAM, N. C.—We are officially advised that Alamance County has voted to issue $200,000 of bonds for new macadam roads. Surveys are now being made, and contracts

will probably be awarded about Feb. 1. D. A. White, Mebane, N. C., Secy. Gilbert C. White, Durham, is Engr.

HILLSBORO, N. C.—We are officially advised that Hillsboro Township will expend about $25,000 for a new macadam road from Hillsboro to the southern part of the county. Plans are now being prepared by Gilbert C. White, Consult. Engr., of Durham, N. C.

PENSACOLA, FLA.—The contract will soon be let for the construction of about ten miles of concrete sidewalks.

HUNTSVILLE, ALA.—The City Council on Dec. 3 adopted an ordinance for paving West Clinton St., space between and 18 ins. on each side of rails of electric and other railroads to be laid in vitrified brick, remainder of street in asphalt, with concrete curbing and vitrified brick gutters. B. D. Lillard is City Clk.

TUSCALOOSA, ALA.—The TUSCALOOSA CONCRETE CO. has secured the contract for constructing 2½ miles of sidewalks here at $6,659. W. H. Nicol is City Engr.

NORTH BIRMINGHAM (Birmingham post-office), ALA.—The city has awarded the contract to C. M. BURKHALTER and to DUNN & LALLANDE BROS., both of Birmingham, for street improvements here. Total cost, about $25,000.

CHATTANOOGA, TENN.—E. P. NORRIS, Duncan Ave. and Spruce St., Chattanooga, has secured the contract at $22,407 for constructing about 4,100 ft. of chert roadway on Eleventh St., with granite curbstone and cement sidewalks.

*HUMBOLDT, TENN.—Bids are asked until 3 p. m., Jan. 1, by the city for grading, graveling and guttering the streets of the city. N. A. Senter is Mayor.

CANTON, OHIO.—Bids are asked by the Board of Public Service until noon, Dec. 29, for improving and paving a portion of West Fifth and other streets. C. A. Zellars is Clk. Bd.

HAMILTON, OHIO.—The Board of Public Service has opened bids as follows for resurfacing and repairing Main St. with asphalt: Barber Asphalt Paving Co., Cincinnati, $19,600; ANDREWS ASPHALT PAVING CO., of Hamilton, $18,840 (awarded contract).

BLUFFTON, IND.—Bids will soon be asked by the Joint Board of Commissioners of Wells and Adams Counties for the construction of a gravel road on the county line.

DECATUR, IND.—The Commissioners of Adams County have awarded contracts to WHEAT & SISK, of Portland, Ind., for the construction of six gravel roads and to JULIUS HAUGH, of Decatur, for the construction of a macadamized road.

FORT WAYNE, IND.—Bids will be received until Dec. 21 by H. W. Becker, City Clk., for repaving with sheet asphalt on portions of numerous streets.

ELKHART, IND.—The Board of Public Works has awarded a contract to the ANDREWS PAVING CO., of Hamilton, Ohio, for paving South Main St. with asphalt, at $45,109.

Plans, on which bids will soon be asked, are being prepared for the paving of Franklin St. with asphalt-macadam.

TIPTON, IND.—Bids will be received by the Board of Commissioners until 10 a. m., Jan. 4, for the construction of 5,300 ft. of gravel road in Liberty Township, 1,327 of gravel road in Cicero Township, 9,266 ft. of gravel road in Jefferson Township; 10,572 ft. of gravel road in Madison Township; and at 2.30 p. m., for the construction of a gravel road on the line between Howard and Tipton Counties.

GREENFIELD, IND.—Bids are asked by the Commissioners of Hancock County until 10 a. m., Jan. 4, for the construction of a gravel road in Brown Township, and a gravel road in Center Township. Charles H. Troy is County Audr.

KOKOMO, IND.—Bids are asked by the Commissioners of Howard County until 2 p. m., Dec. 31, for the construction of 15,829 ft. of gravel road in Howard and Liberty Townships. Wm. L. Benson is County Audr.

CRAWFORDSVILLE, IND.—Bids will be received by the Commissioners of Montgomery County until 10 a. m., Jan. 4, for the construction of a gravel road in Brown Township, known as the Hamm road. B. B. Engle is County Audr.

WABASH, IND.—Bids will be received by the Commissioners of Wabash County until 1.30 p. m., Jan. 5, for the construction of the La Salle gravel road in Wabash township. J. P. Noftzger, is County Audr.

MADISON, IND.—Bids will be received by the Commissioners of Jefferson County until 1 p. m., Jan. 6, for the construction of 5.59 miles of gravel road in Monroe Township. G. F. Grozier is County Audr.

PRINCETON, ILL.—Bids are asked until 3 p. m., Dec. 22, by the Board of Local Improvements for paving several streets. Henry G. Paddock is Secy. Bd.

SHENANDOAH, IOWA.—Bids will probably be asked in the spring for 25 blocks of paving. Thomas W. Keenan is City Clk.

KANSAS CITY, MO.—Contracts for asphalt paving have been awarded, bids opened on Dec. 4, as follows: To PARKER-WASHINGTON CO., 4500 Duncan Ave., St. Louis, Mo., for paving Garfield and Kansas Sts., 5,743 sq. yds., at $1.92; to CLEVELAND TRINIDAD PAVING CO., of Cleveland, Ohio, for Eighth and Wyoming Sts., 7,749 sq. yds., at $2.18, and to BARBER ASPHALT PAVING CO., 410 New Nelson Bldg., Kansas City, for Scarritt St., 2,018 sq. yds., at $1.96.

SPRINGFIELD, MO.—The city has decided to pave Market St. G. W. Hackney is City Clk.

CARTHAGE, MO.—The city is considering paving streets around public square and portions of streets leading to public square. F. B. Newton, City Engr., has estimated that the work will require 600,000 large paving blocks. Estimated cost, about $27,700.

HOUSTON, TEX.—W. I. Heffron & Co., of Houston, submitted the lowest bid on Dec. 1 for paving portions of Preston Ave. and San Jacinto St.

TULSA, OKLA.—The City Council on Dec. 7 awarded contracts as follows for street paving: (a) asphalt, (b) brick: TRINIDAD PAVING CO., Cleveland, Ohio, (a) $54,680 (awarded contract); (b) $10,383 (awarded contract); Parker-Washington Co., 4500 Duncan Ave., St. Louis, Mo., (a) $54,519; (b) $11,232; Barber Asphalt Paving Co., (a) $59,202; The New State Paving Co., (b) $10,840.

ABERDEEN, WASH.—The Council on Dec. 2 awarded contracts to ANDREW PETERSON CO. for street paving here at $102,701.

BREMERTON, WASH.—The contract has been awarded to CHARLES A. WORTH at $1.16 per sq. yd. for laying a cement sidewalk on the east side of Pacific Ave., from Burwell Ave. to Mill St. T. C. Tower, Jr., is City Engr.

TACOMA, WASH.—The Commissioners of Public Works on Nov. 30 awarded the contract for paving Junet, 29th, Proctor, 37th, Stevens and Mason Sts., in the North End District, to the BARBER ASPHALT PAVING CO., Mutual Life Bldg., Seattle, Wash., at $103,270. L. W. Roys is City Clk.

SACRAMENTO, CAL.—Bids will be received until Dec. 18 by the Board of Supervisors, William B. Hamilton, Clk., for constructing a macadam roadway with graded berms and concrete culverts along Upper Stockton Road, a distance of 24 miles. Bids are to be on sections of eight miles each. The upper course of the macadam strip, 16 ft. in width and 4 ft. each side thereof, to be oiled with heavy asphaltic oil.

MANUFACTURING PLANTS.

NEW BEDFORD, MASS.—It is reported that the Harding-Whitman interests, owners of the Whitman, Manomet and Nonquitt mills, are having plans prepared for a new spinning mill, to be built opposite the Nonquitt mill, the latest addition to the plant. The new mill, it is reported, will contain 60,000 to 75,000 spindles, and work of construction will be started early in the spring, according to present plans.

SPRINGFIELD, MASS.—The Springfield Crude Oil Engine Co. has bought a factory site near upper St. James Ave., with frontage on the main line of the Boston & Albany and the Athol branch, for the purpose of erecting a plant for the manufacture of engines. William F. Miller, of Chestnut Hill, is Pres. of the company; Silas L. Kenyon, Treas. and Mgr. of the Fiberloid Co., is Vice-Pres., and Howard R. Bemis, of the Bemis & Call Hardware & Tool Co., is Treas.

BOSTON, MASS.—At a special meeting of the Everett Cotton Mills, of Lawrence, held on Dec. 9, the stockholders voted to double the capital stock of $700,000, for the construction of a new mill.

GREENFIELD, MASS.—We are officially advised that the Goodell-Pratt Co., Greenfield, manufacturers of hand-working tools, has awarded the ABERTHAW CONSTRUCTION CO., 8 Beacon St., Boston, Mass., the contract for erecting foundry. The building, which is to be 75½ ft. wide by 120 ft. long, will be constructed of reinforced concrete throughout and provided with metal sash. The working floor will have a clear span of 44 ft.

LAWRENCE, MASS.—The Pacific Mills, of Lawrence, have let contracts for addftional power-house equipment as follows: To the ALLIS-CHALMERS CO., Milwaukee, Wis., for a steam turbine with turbo jet condenser and generator of 3,250 KW. capacity and additional exciter and switchboard apparatus; to the BIGELOW CO. for twelve additional horizontal return tubular boilers, of practically the same size as those contained in the first installation. These boilers will be supplied with superheaters. A chimney will be built of the same size as the one recently erected, namely 200 ft. high and 9 ft. diameter inside the core. Charles T. Main, 45 Milk St., Boston, is Engr.

HARTFORD, CONN.—The Lawton Mills Co., of Plainfield, Conn., manufacturers of cotton fabrics, has invited bids for the erection of a weave shed and another mill. The weave shed will be a 1-story brick structure, 155 × 227 ft., and the mill will be three stories high, 105 × 182 ft., also of brick.

WARREN, R. I.—Plans for an addition to its present plant are being made by the Warren Mfg. Co., of Warren. The new structure is to be of brick and will be used as a drawing-in room.

NEW YORK, N. Y.—Plans have been filed by J. G. Glover, Arch., 166 State St., Brooklyn, for a 2-story brick and stone store, storage and power-house, 74.10 × 100 ft., to be built at Twelfth Ave. and 131st St., Manhattan, for George F. Hendricks & Co., 33 Hewitt Ave. The building will cost $60,000.

The Moore Estate, 191 Ninth Ave., has had plans filed for a 3-story brick and stone building, to contain stores and factory. The structure will be erected at the corner of Eleventh Ave. and 21st St. and will cost $60,000. F. A. Minuth, 425 Fifth Ave., is Arch.

NIAGARA FALLS, N. Y.—George F. Nye, Industrial Agent for the city, is having plans prepared by Chester R. Phelps, Arch., 163 Gluck Bldg., for a 2-story brick factory of mill construction, to be erected for a company he represents, which will manufacture leather belting.

GENEVA, N. Y.—P. J. Donnely, of Pittsfield, Mass., has completed arrangements to erect in this city a factory for the manufacture of toilet cabinets, medicine cabinet and other bath-room furniture and fixtures.

NORTH TONAWANDA, N. Y.—The Rudolph Wurlitzer Mfg. Co., recently incorporated with a capital of $1,000,000 to consolidate the manufacturing business of the de Kleist Musical Instrument Mfg. Co. of this city and the Rudolph Wurlitzer Co. of Cincinnati, will erect a 3-story brick addition to the North Tonawanda plant. Plans are being prepared and construction work will be started early the coming year.

ELMIRA, N. Y.—The Elmira Cut Glass Co. is having plans prepared for a 2-story brick factory building 45 × 100 ft., which it will erect at the foot of De Witt Ave., at a cost of $10,000.

BUFFALO, N. Y.—The Buffalo Metal Furniture Co. will erect a 2-story brick factory at 1513 Niagara St. William H. Thompson is Mgr., Ross Mfg. Bldg., Niagara St.

M. A. Hanna & Co., of Cleveland, Ohio, have completed the purchase of 52 acres of land on the Niagara River and Erie Canal north of this city and construction work will be commenced early the coming year on two blast furnaces which are to be erected at a cost of $30,000,000. F. C. Mosedale, 606 Ellicott Sq., Buffalo, is Res. Agent. Noted on Dec. 10 and Oct. 22.

GLOVERSVILLE, N. Y.—Louis Myers & Sons will erect an addition, 100 × 137 ft., to their glove manufacturing plant at West Pine and South Main Sts. Plans are being prepared and construction will be commenced early in the spring.

ERIE, PA.—The Cascade Foundry Co. is having plans prepared by J. W. Yard & Son, 808 State St., Erie, Pa., for an addition to its foundry at 19th and Plum Sts., of brick, concrete and steel, 1½ stories, 80 × 100 ft.

WEST MIDDLESEX, PA.—Bovee, Hamilton & Kemp advise us that they will erect a plant to manufacture cement blocks. It has not been decided how many buildings or how much machinery will be required. Work on the plant will be started in the spring.

HIGHLANDTOWN (Baltimore post-office), MD.—Weiskittel & Son, manufacturers of stoves, bathtubs and enameling ironware, will erect a large addition to their plant in Highlandtown. The addition will be two stories high, of brick and reinforced concrete. It will have a frontage of 100 ft., with a depth of 200 ft., and the architectural appearance will conform with the adjacent buildings. The work will involve an outlay of $15,000.

ROSSLYN, VA.—The Columbia Cottonseed Oil & Provision Co., Metropolitan Bank Bldg., Washington, D. C., has had plans prepared by C. A. Coburn, 510 Metropolitan Bank Bldg., Washington, for a factory building, five stories, 105 × 57 ft., of reinforced concrete with slag or concrete roof; elevator, electric wiring, plumbing.

PARSONS, W. VA.—We are officially advised that the Parsons Pulp & Paper Co., of Parsons, has let contract to the ABERTHAW CONSTRUCTION CO., 45 Milk St., Boston, Mass., for constructing a reinforced-concrete digester house. The building will be 100 ft. high and will carry a chip bin, at the top of which two digesters will be directly fed.

ZEBULON, N. C.—The Zebulon Hosiery Mills has increased its capital stock from $10,000 to $18,000, and it will install 50 additional knitting machines, it is stated.

STONY POINT, N. C.—J. W. Watts, of Lilledoun, N. C., proposes forming a company to build a mill containing 4,000 spindles. The plant will be operated by electric power generated from water power and transmitted two miles; 125 to 150 HP. The company will ask bids for erecting buildings about Jan. 1. Machinery is not purchased.

ASHBORO, N. C.—A knitting mill will be established at Ashboro by O. R. Cox, of Thomasville, N. C. Arrangements are being made for the enterprise, and it is stated that $25,000 will be invested.

GREAT FALLS, S. C.—It is reported that W. A. Erwin, of Durham, N. C., will establish a large cotton mill at Great Falls. One of the Southern Power Co.'s electrical plants is at Great Falls.

SUMMERVILLE, GA.—Z. T. McKinney, of Greenville, S. C., is interested in the proposed company to be organized to build a mill at Summerville, Ga. He and his associates propose to build for 10,000 spindles, etc., to manufacture Nos. 30 to 40 yarns, and complement of looms for weaving 38½-in. print cloth. The capital is now being subscribed, and organization probably will be effected soon after Jan. 1.

PENSACOLA, FLA.—Plans for the erection of the proposed cold storage plant for Armour & Co. are being prepared and will be ready soon. Work will be started on the plant just as soon as the contract can be awarded. The plant will be located on the land north of the present plant of the company.

NEW ORLEANS, LA.—We are officially advised that the International Car Co., 1029 Maison Blanche, has let contract for erecting eight buildings to the VIRGINIA BRIDGE & IRON CO., Roanoke, Va., and for woodworking machinery to GREENLEE BROS. CO., Railway Exchange Bldg., Chicago, Ill., and J. A. FAY & EGAN CO., John and Front Sts., Cincinnati, Ohio. The plant will cover 37 acres. The building will be 1-story structure.

KNOXVILLE, TENN.—The Knoxville Pure Milk Co. will erect two extensions to its plant and install additional equipment. An ice-cream refrigerating plant will be installed. Walls of cabinets will be lined with cork 1 ft. thick; two vats with capacity of 300 gallons will be added. Cost of improvements, about $20,000.

LEXINGTON, KY.—A company has been organized for the purpose of manufacturing automobiles in or near Lexington. The articles of incorporation of the Lexington Motor Co. have been filed. The capital stock is $50,000, of which $17,500 has been subscribed. The Lexington parties interested are J. C. Moore, G. B. Wilson, V. K. Dodge and F. O. Young. The Georgetown parties are Kinzea Stone, F. F. Bryan, Benjamin Stone, John Osborne, J. P. Jackson, L. H. McGraw and Charles O'Neil.

FOSTORIA, OHIO.—The Buckeye Stave Co. is preparing to build a new stave factory at Fostoria to take the place of the one burned recently. The loss amounted to $8,000.

MIDDLETOWN, OHIO.—The Wrenn Paper Co. has awarded the contract for the addition to its plant to D. R. STEPHENS, of Covington, Ky., and E. L. FRISCH, of this city. The building will b... stories in height and will be 175 ft. ... by 50 ft. wide and will cost $50,000. ... contractors expect to commence work o... building at once and will have it ready ... the installation of the machinery ear... the spring. The contract for machinery ... been let to the J. H. HORN CO., of La... ce, Mass., at $30,000.

GOSHEN, IND.—The A... tic Roller Bearing Co., of Chicago, Ill., ... contracted with the city of Goshen, In... for a site on which to build a plant, capa... giving em... ployment to 2,500 men. Th... cers of the company are: Thomas R. ... art, Pres.; Thomas W. Reilly, Secy., 11... rk St., Chicago; Isaac A. George, Treas.

The Crescent Motor Car Co... Champlain St., Detroit, has made an ... ment with the city of Goshen, whereb... will move into the plant vacated by the ... no Butter-milk Soap Co.

MISHAWAKA, IND.—The ... ber Regenerating Co., recently incorpor... will build and equip a factory here ... anufacture rubber goods. W. C. Crabill ...

MARQUETTE, MICH.—F. B... ar & Sons will construct a commercial ... It is to be located in the second b... going east on the Lake Street Road, o... the city limits. A spur has been com... to the location of the plant, and much ... the equipment is delivered. The plant ... comprise two Gates crushers, operated ... electricity, and will go into operation in ... spring.

CHICAGO, ILL.—The West... Newspaper Union, 65 Plymouth Pl., is to h... new quarters at the corner of Adams an... Clinton Sts., in a reinforced-concrete steel b... ing, which Adelaine F. Sharp is to erect fo... the concern. The building will be six stories high, with a frontage of 120 ft. on Adams St. and 128 ft. on Clinton St., and with the electric lighting and power plant will cost about $150,000. The building, which was designed by S. N. Crawen, Borland Bldg., Chicago, is to be commenced May 1, and is to be finished the following November. The floors are expected to be able to sustain a weight of 300 lbs. to the square foot. The structure will have an exterior finish of dark paving brick, with terra cotta trimmings.

SHEBOYGAN, WIS.—The Jung Shoe Co. will erect a 2-story brick factory, 100 × 45 ft., in the spring. The present plan is to turn out 500 pairs of shoes daily. Heavy working shoes will be the product at first, with fine grade shoes later.

KANSAS CITY, MO.—Kansas City Stockyards Co. of Missouri is completing arrangements, it is stated, for erection of an S-story live-stock exchange building with a frontage of 268 ft.; new cattle and hog pens and horse and mule barns. The old horse and mule barns are to be razed and cattle and hog pens erected on that site. Cost of improvements, $750,000.

LITTLE ROCK, ARK.—The St. Louis Cotton Compress Co., Third National Bank Bldg., St. Louis, Mo., which operates two compresses and three warehouses at Argenta, Ark., and a compress and warehouse here, is planning to spend between $50,000 and $100,000 on the construction of another compress in this city. It is estimated that the company will handle 250,000 to 275,000 bales by the end of the season. It is the intention to have room another year for at least 350,000 bales.

COEUR D'ALENE, IDAHO.—It is reported that H. L. Fisher, Asst. Engr. of the Spokane Wood Pulp & Paper Co., is interested in a movement to establish a paper mill here the coming year. Estimated cost, $000,000.

QUEBEC, QUE.—The Canadian Northern Quebec Ry. Co. is negotiating for the site for the proposed shops in this city. It is thought that the shops will be built at Limoilou and that they will cost $250,000. D. B. Hanna, Toronto, Ont., is Pres.; F. M. Spaidal, Quebec, is Supt.

WELLAND, ONT.—The Dain Mfg. Co., of Ottumwa, Iowa, will establish a Canadian branch here and will erect a factory for the manufacture of farm implements.

MISCELLANEOUS CONTRACTS.

U. S. RECLAMATION SERVICE.—Items regarding irrigation, canal projects, etc., will be found under Water Supply—Irrigation.

---

*DREDGING.—Mobile, Ala.—Bids are asked until 11 a. m., Jan. 15, by Maj. H. Jervey, Corps Engrs., U. S. A., for dredging in Mobile Harbor.

STEAMBOAT SUPPLIES.—Baltimore, Md.—Bids are asked by the Board of Awards until 11 a. m., Dec. 23, for steamboat supplies. O. F. Lackey is Harbor Engr.

TILE DRAIN.—Rockwell City, Iowa.—Bids are asked by B. E. Stonebraker, County Audr., until Dec. 29, for construction of tile work on Drainage District No. 83.

CEMENT.—New York, N. Y.—Bids are asked by the Department of Parks until 3 p. m., Dec. 24, for furnishing and delivering 500 bbls. of Portland cement for parks, Borough of Manhattan.

DAM.—Dayton, Ohio.—One bid was received on Dec. 5 by the Board of Public Service for constructing the Riverdale dam extension and the repair of the old dam. W. A. Budroe, Clk. The bid received was $2[illegible]00 and was rejected.

COAL TOWER.—San Francisco, Cal.—The Bureau of Equipment, Navy Department, Washington, will award to the HOISTING MACHINERY CO., New York, contract for the construction of a coal tower at San Francisco at $35,875.

DRAIN.—Galveston, Tex.—Bids will be received until Dec. 24 by the Board of City Commissioners for constructing a reinforced concrete drain on Ave. M, approximately 4,520 lin. ft., together with all appurtenances. A. T. Dickey is City Engr.

DITCH.—St. Paul, Minn.—Bids will be received by S. G. Iverson, Secy. State Drainage Commission, until Jan. 2 for the construction of Gun Lake, Minn., state ditch. There are about 332,000 cu. yds. to be excavated. G. A. Ralph, St. Paul, is State Drainage Engr.

LEVEE.—New Orleans, La.—Bids will be received until Dec. 17 by Capt. H. Burgess, U. S. A., Mississippi River Corps Engineer, 3338 St. Charles Ave., New Orleans, for constructing about 13,000 cu. yds. of levee work in the Atchafalaya Levee District.

LUMBER.—New York, N. Y.—Bids will be received until noon, Dec. 22, by Geo. Cromwell, Richmond Boro., New Brighton, for furnishing and delivering 45 M. ft. spruce and 50 M. ft. yellow pine lumber, at the city stable, Columbia St. West, New Brighton.

RETAINING WALL.—Cleveland, Ohio.—Bids are asked at the office of A. R. Callow, Secy. of the Bd. of Public Service, No. 105, City Hall, until noon, Dec. 22, for constructing stone and concrete retaining walls in Rockefeller Park. Work will be let in three sections.

SUBWAY.—Boston, Mass.—Bids are asked until noon, Dec. 29, by the Boston Transit Commission for enlarging Haymarket Square station and subway and building sub-passageway to the Union-Friend station in and near Haymarket Sq., Washington St. tunnel. B. Leighton Beal, Secy.

FIRE ALARM SYSTEM.—New York, N. Y.—Bids were received on Dec. 10 by Nicholas J. Hayes, Fire Comr., for furnishing all the labor and materials required for establishing, completing and equipping an extension of the underground fire alarm telegraph system. The bids exceeded the appropriation and contract has not been awarded.

FIRE ALARM SYSTEM.—New York, N. Y.—Bids were received as follows on Dec. 10 by Nicholas J. Hayes, Fire Comr., for furnishing all the labor and materials required for establishing, completing and equipping an extension of the underground fire alarm telegraph system: Safety Insulated Wire & Cable Co., 114 Liberty St., New York, $33,296 (total); Standard Underground Cable Co., 56 Liberty St., New York, $44,157 (total); Goodman Construction Co., $11,700 (Item No. 1).

(Continued on page 220.)

CONTRACT PRICES.

[Where Prices precedes item under Contract gineering News.]

*PRE—E TUNNEL.—New York, N. Y. —Bids received on Dec. 1 by the Board of Water Supply for constructing the north half of the Walkill pressure tunnel, Contracts Nos. 36 and 37. Itemized bids were as follows: (A) Booth & Flinn, Ltd., 1942 Forbes St., Pittsburg, Pa.; (B) the American Pipe Mfg. Co., Fidelity Bldg., Philadelphia; (C) MacArthur Bros. Co. and Mason & Hanger Co., 11 Pine St., New York, and Richmond, Ky.; (D) Bradley Contracting Co., 1 Madison Ave., New York; (E) S. Pearson & Son, Inc., Long Island City, N. Y.; (F) Winsten Bros. Co. and Arthur McMullen, 21 Park Row, New York, and Minneapolis, Minn.; (G) Millard Construction Co., Pennsylvania Bldg., Philadelphia; (H) MacArthur Bros. Co., 11 Pine St.; (I) Rinehart & Dennis, Washington, D. C.; (J) the Gore-Meenan Co., 203 Broadway, New York; (K) Mason & Hanger, Richmond, Ky. (*bid on Contract No. 36 combined with Contract No. 37. **bid on Contract No. 37 combined with No. 36.)

CONTRACT NO. 36—	(A)*	(B)*	(B)	(C)*	(D)*	(E)*	(F)*	(G)	(H)	(I)
75 lin. ft. construction shaft in earth	$200.00	$300.00	400.00	98.00	128.00	180.50	210.00	120.00	160.00	250.00
285 lin. ft. construction shaft in rock	200.00	350.00	400.00	210.00	180.00	238.00	280.00	200.00	250.00	250.00
75 lin. ft refilling construction shaft	10.00	5.00	5.00	9.50	21.00	14.50	20.00	10.00	9.00	12.00
55 lin. ft waterway and drainage shafts in earth	210.00	300.00	400.00	160.00	208.00	168.00	300.00	120.00	80.00	250.00
9,300 cu. yds. rock excavation in waterway and drainage shafts	9.60	15.00	20.00	14.00	17.00	16.00	30.00	12.00	14.00	15.00
125,000 cu. yds. excavation of pressure tunnel and drainage drift	5.75	6.00	6.30	6.10	7.00	6.30	6.50	6.60	6.40	7.75
300 cu. yds. additional trimming in shafts, tunnel and drift	3.00	5.00	5.00	8.00	5.60	8.00	3.00	10.00	7.40	8.00
600,000 lbs. furnishing structural steel roof support	.03	.05	.05	.05	.03	.06¼	.04	.05	.05	.04
600,000 lbs. erecting structural steel roof support	.03	.03	.03	.03	.03	.01	.01	.01	.03	.04
65 M. ft. B. M. temporary timbering	80.00	100.00	100.00	70.00	70.00	75.00	60.00	80.00	68.00	60.00
200,000 mil. ft. gals. pumping from shafts and pressure tunnel during construction	.30	.30	.30	.62	.10	.35	.35	.60	.73	.30
12,850 lin. ft. drainage channels for shafts and pressure tunnel	2.00	2.00	2.00	2.60	2.80	2.20	2.00	2.50	2.30	2.50
827 lin. ft of shaft forms for lining of waterway shaft and outer lining of dr. shaft	7.00	10.00	10.00	8.00	14.00	5.00	10.00	7.00	8.40	7.00
960 lin. ft. of shaft forms for inner lining of drainage shaft	7.00	12.00	12.00	8.00	14.00	5.00	10.00	7.00	8.00	7.00
11,675 lin. ft. of tun. & dr. forms for lining of tunnel and drainage drift	3.00	4.00	4.00	5.20	4.90	5.00	3.50	3.50	5.00	3.00
5,000 cu. yds. concrete masonry in shafts	12.00	8.00	8.00	9.00	7.00	7.00	8.00	8.00	9.00	10.00
40,000 cu. yds. concrete masonry in tunnel and drainage drift	5.50	6.10	6.10	7.35	5.85	7.00	8.00	7.00	7.40	7.00
2,500 cu. yds. excess concrete masonry in shafts, tunnel and drift	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
200 cu. yds. brick masonry in shafts and tunnel	17.00	15.00	15.00	20.00	28.00	20.00	20.00	20.00	18.00	20.00
3,500 cu. yds. dry packing in pressure tunnel	3.00	3.00	3.00	2.40	2.50	3.00	4.00	3.00	2.70	3.00
17,500 sq. ft. drainage interlining in drainage shaft	.20	.30	.30	.32	.40	.25	.75	.30	.32	.30
7,500 lbs. furnishing & erect. steel castings & erect. spec. valves in dr. & sh	.12	.12	.12	.10	.10	.12	.25	.20	.16	.15
8,500 lbs. bronze access door and frame	.75	1.00	1.00	.90	.75	.60	.75	.80	.90	.80
60,000 lbs. structural steel interlining in drainage drift and tunnel	.08	.08	.08	.08	.06	.08	.12	.08	.09	.10
450 sq. ft. cutting channels for water-stops	2.00	2.00	2.00	1.75	3.00	1.00	4.00	2.00	1.80	2.00
415 lin. ft. lead-lined 16-in. cast-iron pipe and specials	30.00	20.00	20.00	25.00	35.00	18.75	40.00	25.00	25.00	30.00
1,250 lin. ft. drilling 1¼-in. or smaller holes in rock or masonry	.40	.50	.50	.50	.50	.40	.40	.40	.40	.50
1,250 lin. ft. drilling 1¾-in. to 2½-in. holes in roc	.45	.60	.60	.60	.50	.50	.50	.60	.50	.60
20,000 lin. ft. steel pipe for grouting, etc	.20	.30	.30	.30	.25	.25	.30	.25	.26	.30
Miscellaneous plant and equipment for grouting (lump sum)	2,500.00	4,000.00	8,000.00	4,650.00	5,000.00	2,500.00	2,500.00	5,000.00	5,000.00	3,000.00
5 high-pressure air-compressors for grouting	600.00	300.00	300.00	300.00	1,000.00	350.00	500.00	1,200.00	330.00	500.00
5 tank grouting machines	250.00	250.00	250.00	300.00	250.00	450.00	300.00	300.00	320.00	500.00
25 grouting pads	70.00	50.00	50.00	100.00	60.00	69.00	150.00	100.00	110.00	100.00
3,500 making connections of tank grouting machines to grout pipes	.50	1.00	1.00	1.00	2.00	.83	1.00	1.00	1.00	1.50
1,000 setting grouting pads	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00
1,850 tons sand for grout	1.60	2.00	2.00	1.70	2.00	1.56	2.50	2.00	1.70	2.00
2,500 cu. yds. mixing and placing grout	5.00	5.00	5.00	7.00	3.00	10.00	6.00	4.00	7.00	4.00
8,000 cu. yds. earth excavation in open cut	.50	.60	.60	.60	1.00	.75	.35	.80	.70	.50
14,000 cu. yds. refilling and embanking	.50	.50	.50	.40	.70	.50	.60	.50	.50	.40
18,500 cu. yds. excavating top soil	.50	.50	.50	.50	.55	.50	.40	.60	.50	.60
17,500 cu. yds. surface dressing of earth	.50	.30	.30	.40	.70	.50	.60	.50	.50	.60
40 M. ft. B. M. timber and lumber	80.00	50.00	50.00	60.00	70.00	60.00	50.00	50.00	60.00	60.00
2,200 cu. yds. rock excavation in open cut	3.00	2.50	2.50	1.50	3.50	2.50	1.50	2.00	1.80	2.00
2,100 cu. yds. concrete masonry in open cut	6.50	7.75	7.75	7.75	8.00	7.00	6.00	5.80	8.00	7.00
175 cu. yds. reinforced concrete not in tunnel	7.00	9.00	9.00	13.00	12.00	8.60	8.00	7.00	13.00	20.00
22,000 lbs. steel for reinforcing concrete	.04	.03	.03	.05	.03	.04	.04	.04	.05	.06
2,900 lbs. miscellaneous cast iron, wrought iron and steel	.12	.10	.10	.07	.05	.17½	.10	.10	.07	.06
101,000 bbls. Portland cement	1.50	1.50	1.50	1.39	1.70	1.90	1.80	2.06	1.39	1.60
125,000 lbs. sulphate of alumina for waterproofing concrete, mortar or grout	.02½	.02	.02	.03	.03	.02	.03	.02	.03	.03
10 tons cast-iron pipe and special pipe castings	80.00	100.00	100.00	100.00	100.00	90.00	80.00	100.00	112.00	100.00
3 10-in. and smaller sluice-gates	125.00	60.00	60.00	100.00	75.00	100.00	75.00	100.00	100.00	100.00
6,800 lbs. bronze pipe and miscellaneous bronze	1.00	.80	.80	.90	.75	.75	.80	1.00	.90	.80
100 lin. ft. vitrified pipe	.75	1.00	1.00	.60	.50	.75	1.50	1.00	.60	2.00
225 cu. yds. dry rubble masonry and paving	4.00	3.00	3.00	4.00	2.50	500	4.00	4.00	4.00	4.00
50 cu. yds. rubble masonry and paving in mortar	5.50	3.50	3.50	5.00	4.00	5.50	5.00	6.00	5.00	5.00
1,475 cu. yds. surfacing permanent roads	2.50	3.00	3.00	2.50	7.00	2.50	2.50	2.50	2.70	3.00
60 lin. ft. reinforced-concrete ladders	3.00	2.00	2.00	3.00	10.00	3.00	10.00	2.00	3.50	5.00
Moving DuBois house (lump sum)	5,000.00	2,500.00	2,500.00	2,000.00	1,000.00	1,000.00	2,500.00	2,000.00	2,000.00	2,000.00
2 locker houses	1,500.00	1,750.00	1,750.00	750.00	500.00	1,270.00	1,500.00	1,000.00	1,000.00	1,000.00
Cleaning up (lump sum)	5,000.00	2,500.00	2,500.00	1,500.00	3,000.00	3,000.00	3,000.00	10,000.00	2,400.00	2,500.00
Total	$1,718,393	$1,889,785	$2,005,185	$1,973,310	$1,973,280	$1,989,082	$2,204,120	$2,031,180	$2,045,595	$2,140,529
(Time, 47 months. Bond required, $450,000.)										

CONTRACT NO. 37—	(A)**	(D)**	(B)**	(B)	(C)**	(E)**	(F)**	(K)	(G)	(J)
50 lin. ft. construction shafts in earth	$200.00	$128.00	$300.00	$300.00	$96.00	$180.50	$210.00	$104.00	$120.00	$100.00
660 lin. ft. construction shafts in rock	200.00	180.00	350.00	350.00	210.00	238.00	280.00	225.00	200.00	225.00
50 lin. ft. refilling construction shafts	10.00	21.00	5.00	5.00	8.00	14.50	20.00	9.00	10.00	10.00
50 lin. ft. waterway shaft in earth	210.00	208.00	300.00	300.00	74.00	168.00	300.00	88.00	120.00	100.00
3,700 cu. yds. rock excavation in waterway shaft	9.60	17.00	15.00	15.00	14.00	16.00	30.00	13.00	12.00	12.00
127,500 cu. yds. excavation of pressure tunnel	5.75	7.00	6.00	6.00	6.00	6.30	6.50	5.90	6.30	6.25
300 sq. yds. additional trimming in shafts and tunnel	3.00	5.60	5.00	5.00	8.00	8.00	3.00	7.30	10.00	10.00
615,000 lbs. furnishing structural steel for roof support	.03	.03	.05	.05	.05	.06¼	.04	.05	.04	.04
615,000 lbs. erecting structural steel roof support	.03	.03	.03	.03	.02½	.01	.01	.03	.01	.04
65 M. ft. B. M. temporary timbering	80.00	70.00	100.00	100.00	60.00	75.00	60.00	66.00	60.00	60.00
200,000 mil. ft. gals. pumping from shafts and pressure tunnel during construction	.30	.10	.30	.30	.62	.35	.35	.65	.60	.35
12,900 lin. ft. drainage channels for shafts and pressure tunnel	2.00	2.80	2.00	2.00	2.40	2.20	2.00	2.30	2.50	2.50
395 lin. ft. of sh. forms for lining of waterway shaft	7.00	14.00	10.00	10.00	8.00	5.00	10.00	8.40	7.00	8.00
11,800 lin. ft. of tun. forms for lining of tunnel	3.00	4.90	4.00	4.00	5.20	5.00	3.50	4.60	3.50	3.00
2,800 cu. yds. concrete masonry in shafts	12.00	7.00	8.00	8.00	8.30	7.00	8.00	8.75	7.00	10.00
50,500 cu. yds. concrete masonry in tunnel	5.50	5.85	6.10	6.10	7.35	7.00	8.00	7.25	6.80	7.75
2,500 cu. yds. excess concrete masonry in shafts and tunnel	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
200 cu. yds. brick masonry in shafts and tunnel	17.00	28.00	15.00	15.00	17.50	20.00	20.00	18.00	20.00	15.00
3,500 cu. yds. dry packing in pressure tunnel	3.00	2.50	3.00	3.00	2.40	3.00	4.00	2.70	3.00	3.50
1,250 lin. ft. drilling 1¼-in. or smaller holes in rock or masonry	.40	.50	.50	.50	.50	.40	.40	.40	.40	.40
1,250 lin. ft. drilling 1¾-in. to 2½-in. holes in rock or masonry	.45	.50	.60	.60	.60	.50	.50	.50	.60	.50
20,000 lin. ft. steel pipe for grouting, etc	.20	.25	.30	.30	.30	.25	.30	.26	.25	.25
Miscellaneous plant and equipment for grouting, lump sum	2,500.00	5,000.00	4,000.00	8,000.00	4,650.00	2,500.00	2,500.00	5,000.00	5,000.00	5,000.00
5 high pressure air-compressors for grouting	600.00	1,000.00	300.00	300.00	300.00	350.00	500.00	330.00	1,200.00	300.00
5 tank-grouting machines	250.00	250.00	250.00	250.00	300.00	450.00	300.00	320.00	300.00	300.00
25 grouting pads	70.00	60.00	50.00	50.00	100.00	69.00	150.00	110.00	100.00	150.00
3,500 making connections of tank grouting machines to grout pipes	.50	2.00	1.00	1.00	1.00	.83	1.00	.95	1.00	.75
1,000 setting grouting pads	1.00	2.00	1.00	1.00	1.00	1.00	2.00	1.10	1.00	1.00
1,850 tons sand for grout	1.60	2.00	2.00	2.00	1.75	1.56	2.50	1.60	2.00	1.50
2,600 cu. yds. Mixing and placing grout	5.00	3.00	5.00	5.00	7.20	10.00	6.00	7.00	6.00	10.00
3,000 cu. yds. excavation in open cut	.50	1.00	.60	.60	.60	.75	.35	.66	.80	.60
11,000 cu. yds. refilling and embanking	.50	.70	.50	.50	.40	.50	.60	.49	.60	.50
8,700 cu. yds. excavating top-soil	.50	.75	.50	.50	.50	.50	.40	.48	.60	.50
13,500 cu. yds. surface dressing of earth	.50	.50	.30	.30	.50	.50	.60	.51	.60	.50
5 M. ft. B. M. timber and lumber	80.00	70.00	50.00	50.00	56.00	60.00	50.00	60.00	60.00	60.00
1,450 cu. yds. concrete masonry in open cut	6.50	8.00	7.75	7.75	7.00	7.00	6.00	7.75	5.80	7.00
125 cu. yds reinforced concrete not in tunnel	10.00	12.00	9.00	9.00	12.00	8.00	8.00	12.70	8.00	15.00
22,000 lbs. steel for reinforcing concrete	.04	.03	.03	.03	.05	.04	.04	.05	.04	.05
200 lbs. miscellaneous cast iron, wrought iron and steel	.12	.05	.10	.10	.07	.17½	.10	.07	.10	.10
98,000 bbls. Portland cement	1.50	1.70	1.50	1.50	1.39	1.90	1.80	1.60	1.50	1.50
121,000 lbs. sulphate of alumina for waterproofing concrete, mortar or grout	.02½	.03	.02	.02	.03	.02	.03	.03	.02	.03
10 tons cast-iron pipe and special pipe castings	80.00	100.00	100.00	100.00	100.00	90.00	80.00	104.00	100.00	100.00
1 ten-inch and smaller sluice-gates	125.00	75.00	60.00	60.00	100.00	100.00	75.00	100.00	100.00	100.00
1,300 lbs. bronze pipe and miscellaneous bronze	1.00	.75	.80	.80	.90	.75	.80	.88	.80*	1.00
100 lin. ft. vitrified pipe	.75	.50	1.00	.60	.75	1.50	1.50	.50	1.00	.50
50 cu. yds. dry rubble masonry and paving	4.00	2.50	3.00	3.00	4.00	5.00	4.00	3.90	4.00	4.00
50 cu. yds. rubble masonry and paving in mortar	5.50	4.00	3.50	3.50	5.00	5.50	5.00	4.90	6.00	6.00
275 cu. yds. surfacing permanent roads	2.50	7.00	3.00	3.00	2.50	2.50	2.50	2.70	2.70	3.00
25 lin. ft. reinforced concrete ladders	3.00	10.00	2.00	2.00	3.00	3.00	10.00	3.20	2.00	4.00
3 locker houses	1,500.00	5,000.00	1,750.00	1,750.00	750.00	1,270.00	1,500.00	880.00	1,000.00	1,000.00
Clearing up, lump sum	5,000.00	5,000.00	2,500.00	2,500.00	1,500.00	2,500.00	3,000.00	2,400.00	5,000.00	5,000.00
Total	$1,647,074	$1,853,750	$1,853,847	$1,857,847	$1,871,849	$1,921,071	$2,050,522	$1,888,065	$1,889,672	$1,891,973
(Time, 47 months; bond: $450,000.)										

LIFT BRIDGE.—Rochester, N. Y.—Bids in detail were received as follows on Dec. 3 by F. C. Stevens, Supt. Public Works, Albany, for construction of a lift bridge over the Erie Canal at Lyell Ave. and at Allen St., Rochester. (A) W. J. BURNS CO., Syracuse, N. Y.; (B) Owego Bridge Co., Owego, N. Y.; (C) Penn Bridge Co., Beaver Falls, Pa.; (D) Seneca Engineering Co., Montour Falls, N. Y.; (E) Houston Barnard, Rochester, N. Y; (F) M. Fitzgerald, Hoosick Falls, N. Y.; (G) Montour Steel Co., Montour Falls, N. Y.:

Lyell Ave.—	(A)	(B)	(C)	(D)	(E)
2,300 cu. yds. excavation	$1.20	$2.00	$1.60	$2.00	$1.80
650 cu. yds. embankment	.28	.50	.50	.36	.20
800 cu. yds. second-class concrete	7.75	10.00	10.00	12.80	9.75
10 cu. yds. lining	2.00	2.00	2.50	2.70	2.25
600 sq. yds. approach pavement	2.50	3.00	3.00	3.35	3.00
2,400 sq. ft. concrete sidewalk	.20	.30	.16	.24	.15
100 lin. ft. new curb	1.50	2.00	1.10	.98	1.20
160 lin. ft. curb reset	.75	1.00	.25	.36	.45
10 sq. ft. vault light	2.50	2.00	1.00	2.50	2.00
25,000 lbs. reinforcement	.04	.05	.04	.04	.035
212,000 lbs. structural steel	.0512	.08	.049	.065	.055
22,000 lbs. machinery	.13	.20	.12	.27¼	.15
220 sq. yds. wood pavement	3.00	3.00	3.25	5.70	3.00
4 M. ft. Y. P. sawed lumber	55.00	50.00	40.00	80.00	55.00
170 lin. ft. lattice rail	2.20	3.00	2.50	3.00	2.00
Electric equipment (lump sum)	2,495.00	4,000.00	2,518.00	2,800.00	3,000.00
Operator's cabin (lump sum)	365.00	300.00	300.00	1,250.00	300.00
Safety gates (lump sum)	500.00	500.00	450.00	1,500.00	300.00
Rebuilding foot-bridge (lump sum)	500.00	300.00	520.00	860.00	400.00
Credit for old superstructure	310.00	100.00	100.00	500.00	100.00
Total	$30,970	$44,775	$33,375	$46,715	$35,392
Allen St.	(F)	(A)	(C)	(G)	(E)
3,500 cu. yds. excavation	$0.60	$0.72	$2.00	$1.83	$1.40
1,400 cu. yds. forming embankment	.15	.23	.50	.37	.20
1,050 cu. yds. second-class concrete	8.50	7.50	9.00	12.60	9.75
10 cu. yds. lining	1.00	2.00	1.60	2.60	2.25
450 sq. yds. approach pavements	3.00	2.50	1.75	3.16	2.00
1,600 sq. ft. Portland cement sidewalks	.20	.20	.18	.23	.15
100 lin. ft. new curb stones	1.00	1.50	.82	.95	1.20
50 lin. ft. curb stones reset	.50	.75	.40	.38	.45
24 sq. ft. vault lights	.50	2.50	1.00	2.10	2.00
1,000 sq. ft. stairways and foot bridge floor	.40	.42	.20	.53	.30
23,000 lbs. metal reinforcement	.0375	.0395	.04	.04	.035
2,000 lbs. cast-iron pipe	.03	.05	.03	.125	.05
215,000 lbs. structural steel	.045	.0478	.049	.058	.0525
20,000 lbs. machinery	.08	.13	.12	.245	.15
200 sq. yds. wooden pavement	3.00	3.00	3.80	5.50	3.00
4,000 ft. B. M. Y. P. sawed lumber, per M.	55.00	60.00	40.00	75.00	55.00
210 lin. ft. lattice railings	2.00	2.00	2.00	3.95	2.00
Electrical equipment complete (lump sum)	2,500.00	2,495.00	2,518.00	2,670.00	3,000.00
Operator's cabin, complete (lump sum)	300.00	365.00	300.00	1,100.00	300.00
Safety gate, complete (lump sum)	100.00	500.00	450.00	1,100.00	300.00
Deduct price to be paid by the Contractors to the State of New York for the existing superstructure	100.00	285.00	100.00	300.00	100.00
Total	$29,685	$31,070	$36,990	$48,003	$37,453

MISCELLANEOUS CONTRACTS.

(Continued from page 219.)

WHARF.—Norfolk, Va.—The Bureau of Yards and Docks, Navy Department, Washington, will award contract for the construction of a wharf to WILLIAM L. MILLER, Boston, Mass., at $28,749, and for necessary dredging in connection with the work to the NORFOLK DREDGING CO., Norfolk, Va., at $7,435.

DITCH.—Houston, Tex.—Bids are asked by the Board of Drainage Commissioners of the Harris County Drainage District No. 1 at the office of George F. Horton, Drainage Engr., Houston, until 3 p. m., Jan. 6, for the entire work or for any division or section thereof for approximately 350,000 cu. yds. of ditching, depth 4 to 5 ft., base 4 to 20 ft., with 1 to 1 slope.

OILS, STONE.—New York, N. Y.—Bids are asked by Louis F. Haffen, Pres. Boro. The Bronx, until 11 a. m., Dec. 24, for furnishing and delivering 100,000 gallons of crude oil mixture, equal to sample, to be furnished and delivered as directed in bulk to any railroad station in the Borough of The Bronx; also for furnishing and delivering broken trap-rock stone or screenings.

REPAIRING FERRYBOATS.—New York, N. Y.—Bids were received by Allen N. Spooner, Dock Comr., on Dec. 3 for furnishing all the labor and materials required for repairing the municipal ferryboats, or other floating ferry property, and furnishing and delivering supplies therefor. JAMES SHEWAN & SON, foot of East Houston St., have secured the contract, at $53,865.

CEMENT.—New York, N. Y.—Bids were received on Nov. 19 by Allen N. Spooner, Comr. Docks (Contract No. 1152), for furnishing all the labor and materials required for furnishing and delivering cement: Class 1-A, 5,000 barrels of cement; Class 1-B, 20,000 bags of cement. Contract has been awarded to JOHN P. KANE CO., 103 Park Ave., at (1-A) $1.47 per bbl., and (1-B) 29¼ cts. per bag.

*DREDGING.—Boston, Mass.—Bids were received as follows on Dec. 9 by Lieut-Col. Edw. Burr, Corps Engrs., U. S. A., for dredging in Essex River, Mass—(a) dredging, (b) rock removal, price per cu. yd.: Bay State Dredging Co., 185 Summer St., Boston, (a) 38¾ cts., (b) $12; Eastern Dredging Co., 247 Atlantic Ave., Boston, (a) 42.8 cts., (b) $3. The amount available for this work is $11,500.

CAR LIGHTING.—Ottawa, Ont.—The Railway Commission has issued an order that in future all cars must be lighted by Pintsch compressed oil gas or by acetylene gas under absorbent or commercial acetylene gas system. Railroads contravening this act will be liable to a fine of $100 for every offense and employees and officials disobeying the order will be fined $20 for each offense. Use of electricity is not prohibited.

DAM, BRIDGE WORK.—Chicago, Ill.—Bids were received as follows on Dec. 9 by the Sanitary District of Chicago for building a reinforced-concrete dam, and for performing certain collateral bridge work. The bidders (all of Chicago) were: James O. Heyworth, $80,082; John W. Page, $82,625; National Contracting Co., $82,748; Standard Construction Co., $93,099; Great Lakes Dredge & Dock Co. List of itemized bids received for this work on Nov. 18, was given in issue of Dec. 3.

DREDGING.—Boston, Mass.—One bid was received by the Board of Harbor and Land Commissioners, Boston, on Dec. 4, for dredging the channel of the South River, Salem. The work to be done is the dredging of about 22,000 cu. yds. scow measurement, of material to make the channel 8 ft. deep at mean low water, from about 200 ft. below Union St. bridge to the westerly boundary of the Salem Electric Lighting Co.'s premises, a distance of about 1,300 ft. The bid received was that of John H. Gerrish, 247 Atlantic Ave., Boston.

*DREDGING.—Savannah, Ga.—Bids were received as follows per cu. yd. on Dec. 9 by Col. Dan C. Kingman, Corps Engrs., U. S. A., for dredging 100,000 cu. yds. in waterway between Savannah, Ga., and Fernandina, Fla.: Savannah Dredging Co., Savannah, 24½ cts.; Atlantic Dredging Co., Philadelphia, Pa., $24½ cts.; P. Sanford Ross, Inc., 277 Washington St., Jersey City, 24.4 cts.; Coastwise Dredging Co., Norfolk, Va., 26½ cts.; Simons-Mayaut Co., Charleston, S. C., 17.9 cts. (recommended for acceptance). The contractor will use 12-in. suction dredge.

COLLIERS.—Washington, D. C.—Bids were received as follows on Dec. 15 at the office of the Secretary of the Navy, Washington, for furnishing one steel steam collier of 12,500 tons cargo and capacity. Bids were asked on hulls of two designs: Newport News Shipbuilding & Dry Dock Co., Newport News, Va., (a) $790,000, (b) $825,000, 16 months; Fore River Shipbuilding Co., Quincy, Mass., (a) $933,000, (b) $954,000, 15 months; New York Shipbuilding Co., Camden, N. J., (a) $1,074,000, (b) $1,104,000 using Lidgerwood machinery; Maryland Steel Co., Sparrow's Point, Md., (a) $993,800, (b) $1,011,400, (c) $1,027,350, 16 months; William Cramp Ship & Engine Building Co., Philadelphia, (a) $805,000, (b) $775,000.

SUBMARINES.—Washington, D. C.—The Secretary of the Navy, Washington, has awarded contract for the construction of submarine vessels, for which bids were received Nov. 2. To the ELECTRIC BOAT CO., two boats under their 20-A bid, at $450,450 each, and two boats under their 20-D bid, at $438,900 each, all four boats to be built on the Pacific Coast. To the LAKE TORPEDO BOAT CO., one boat at $410,000, to be built by the Newport News Shipbuilding & Dry Dock Co., Newport News, Va. To the AMERICAN LAURENTI CO., one boat at $437,500, to be built by William Cramp & Sons' Ship & Engine Building Co., Philadelphia, Pa. The two remaining boats authorized by Congress will be built at a Government yard, if satisfactory arrangement can be made with one or more of the submarine boat companies.

SUBWAY.—Boston, Mass.—The Boston Elevated Railway Co. has filed with the Railroad Commission its preliminary estimate of cost of constructing the Cambridge Main St. subway and the East Cambridge extension. The East Cambridge extension, an elevated structure from the North Station to Lechmere Square, Cambridge, will cost $4,300,000, as follows: Real estate, $613,781; abutters' damages, $1,148,000; miscellaneous land, $100,000; foundations, $900,000; steel structure, $336,050; track system, $143,475; double trolley poles, $15,765; stations, $125,000; miscellaneous, $52,000; viaduct over Charles River, $505,000; engineering, general expenses and contingent, $389,907; total, $4,288,978. A preliminary estimate of the cost of the Cambridge Main St. subway, from Beacon Hill tunnel, over the West Boston Bridge, under Main St. and Massachusetts Ave. to Harvard Square, is $6,350,300. An estimate in 1905 placed the cost at $6,159,000. The detailed expenses are: Real estate and damages, $210,000; two track subway from near First St. to Quincy Sq., $3,195,000; subways, stations and inclines west of Quincy Sq., $1,413,000; Central Square station, $200,000; Sixth St. station, $115,000; terminal yard and car house, $250,000; ten per cent. for contingencies, $517,300; total, $5,690,300; equipment, $450,000; total, $6,350,300.

U. S. POSSESSIONS AND CUBA.

BRIDGE.—Alaska.—A bridge contract has been placed by the American Securities Co. for a bridge over the Copper River in Alaska with the AMERICAN BRIDGE CO., 30 Church St., New York. It will require 3,300 tons of steel.

BRIDGE.—Philippines.—Through the Steel Products Co., the foreign selling agents of the United States Steel Corporation, the AMERICAN BRIDGE CO., 30 Church St., New York, was awarded a contract to supply 26 duplicate spans of material for a railroad bridge in the Philippine Islands.

DREDGING.—Hawaii.—The Bureau of Yards and Docks, Navy Department, Washington, will award contract for dredging at the Naval Station, Honolulu, Hawaii, to the HAWAIIAN DREDGING CO., Honolulu, H. T., at its bid of $3,560,000. Full list of bids was given on Dec. 3. (Bids were received on Dec. 1.)

LUMBER.—Philippines.—Bids will be received until Dec. 22 by Maj. W. S. Wood, Quartermaster, U. S. A., 322 Arcade Annex, Seattle, Wash., for furnishing and delivering at Seattle or Tacoma, Wash., or other ports of Puget Sound accessible to vessels of deep draft, 2,000 M. ft. fir lumber, and 60 M. ft. of hard wood for shipment to Manila, P. I.

TOWING MACHINES. — Panama. — Bids were received as follows on Dec. 9 at the office of the Isthmian Canal Commission, Washington, for furnishing twelve towing machines for the Isthmian Canal: American Ship Windlass Co., Providence, R. I., $21,875; time, 105 days. Chase Machine Co., Cleveland, Ohio, $22,960; time, 110 days.

PUMPING PLANT.—Cuba.—Bids are asked until Dec. 28 by the Secretaria de Obras Publicas for the delivery and installation of a pumping plant for the water-works of Camaguey, Cuba. The plant will consist of one triple expansion high duty pumping engine, with all auxiliaries; two water tube boilers, and one economizer. The pumping engine will be of the vertical type and will be capable of pumping 2,200 gals. per min. against a pressure of 355 ft. Further information and specifications can be obtained from Sr. D. Lombillo Clark, Director General of Public Works, Arsenal, Havana, Cuba.

DRYDOCK.—Hawaii.—Bids are asked until 11 a. m., Feb. 13, by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for constructing a concrete and granite drydock approximately 1,140 ft. long, 130 ft. wide and 35 ft. deep, at the Naval Station, Pearl Harbor, Hawaii. Plans and specifications can be had at the Bureau or will be furnished by the commandant of the naval station named after Dec. 14 upon a deposit of $100 as security for their return. R. C. Hollyday, Chief of Bureau.

RAILS.—Panama.—Bids were received as follows on Dec. 12, at the office of the Isthmian Canal Commission, Washington, D. C., for furnishing 1,100 tons of steel rails, 70-lb.: Bethlehem Steel Co., South Bethlehem, Pa., $33,825; 30 days; seconds, $29.75 per ton. R. C. Hoffman & Co., Baltimore, Md., $34,100; 55 days. Lackawanna Steel Co., New York, $33,330; 40 days. United States Steel Products Export Co., New York, $33,550; 65 days; seconds, $29.50 per ton.

CIVIL SERVICE EXAMINATIONS.

METALLOGRAPHIST.—Watertown, Mass.—The U. S. Civil Service Commission announces an examination on Jan. 13, to secure eligibles from which to make certification to fill a vacancy in the position of Metallographist (male), $1,200 a year, Ordnance Department at Large, Watertown Arsenal, Mass., and vacancies requiring similar qualifications as they may occur. Age limit, 20 years. Application Form 1312. Applications must be filed prior to closing hour on Jan. 2.

JUNIOR PHYSICIST.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on Jan. 13-14, to secure eligibles from which to make certification to fill a vacancy in the position of Junior Physicist in the Technologic Branch of the Geological Survey, at a salary ranging from $1,080 to $1,500 a year, and vacancies requiring similar qualifications as they may occur in that survey. Age limit, 21 years. Application Form 1312. Applications must be filed prior to closing hour on Jan. 2.

CHEMIST.—Dover, N. J. The U. S. Civil Service Commission announces an examination on Jan. 13-14, to secure eligibles from which to make certification to fill a vacancy in the position of Chemist, $1,600 a year, a vacancy in the position of Assistant Chemist at $1,400 a year, both at the Picatinny Arsenal, Dover, N. J., and vacancies requiring similar qualifications as they may occur in the Ordnance Department at Large. Age limit, 20 years. Application Form 1312. Applications must be filed prior to closing hour on Jan. 2.

ELECTRICIAN'S HELPER.—Washington D. C.—The U. S. Civil Service Commission announces an examination on Jan. 13, to secure eligibles from which to make certification to fill a vacancy in the position of Electrician's Helper, $50 a month, in the office of the Secretary, Department of Agriculture, and vacancies requiring similar qualifications as they may occur in any branch of the service. With reference to the specific vacancy mentioned the Department states that the length of time that it will be able to retain the services of an Electrician's Helper depends on the amount of work that comes into the shop and also the funds available for the employment of a helper, both of which are impossible to determine in advance. Age limit, 18 years. Application Form 1093.

TEACHER, ASSISTANT.—Philippines—An examination will be held on Dec. 29-30 by the U. S. Civil Service Commission, Washington, D. C., to fill a large number of vacancies in the positions of Clerk and Teacher in the Philippine Service. The entrance salary of the major[ity] of the appointees will be $1,200 a [year], some appointments may be [made] at salaries of $1,000 or $1,100, based upon experience and relative standing in the examination, and they will [be eligible] for promotion up to $2,000 a year. Eligibility in the assistant [grade] required for promotion to [the] division superintendent, which [is] ranging from $1,600 to $3,000 [a year]. American men teachers are [appointed] for supervisory character, and the [positions] are filled as vacancies occur [by promotion] of those who have demonstrated [their] efficiency and ability in the [service]. Heretofore the majority of those [appointed] to the assistant examination [were willing] to accept appointment as teachers [have been] selected. Others will be [appointed] for various clerical and administrative [offices] in the islands. Men only will be [admitted] to the examination for assistant; [women] will not be admitted to the teacher [examination] unless they are the wives, [unmarried] relatives, or fiancees of men [appointed] for teacher or assistant or appointed [or already] employed in the Philippines. [Applications] for teacher. Each woman applicant [must] state definitely in her application [her name], address, and relationship of [husband]. Age limit, 18 to 40 years. [Person.] Forms 2 and 375. [Application]

For other Proposal Advertisements see pages 43, 44, 49, 50, [Miscellaneous] Advertisements and Construction News page 220.

CONSTRUCTING QUARTERMASTER'S OFFICE, FORT MEADE, S. D. December 12th, 1908.—Sealed proposals, in triplicate, will be received at this office until 10 A. M., Mountain Time, January 18th, 1909, and then opened, for constructing one Hay Shed. Plans and specifications may be seen by intending bidders at the offices of the Chief Quartermaster, Department of the Missouri, Omaha, Nebraska; Department of the Colorado, Denver, Colo.; Department of the Lakes, Chicago, Ill.; Department of Dakota, St. Paul, Minn., and this office, at which latter place all information may be obtained upon application. A deposit of $10.00, to insure return, is required before plans are sent on individual application. The United States reserves the right to reject any or all bids or to accept any part of a bid that may be advantageous to the Government. Envelopes containing proposals should be endorsed "Proposals for Hay Shed, Fort Meade, S. D.," and addressed to L. C. SCHERER, Captain and Q. M., 4th Cavalry, Constructing Quartermaster.

NOTICE TO CONTRACTORS.—Sealed bids for enlarging Haymarket Square Station and Subway and building subpassageway to the Union-Friend Station in and near Haymarket Square, Washington Street Tunnel, will be received by the undersigned until 12 o'clock M. of Tuesday, December 29, 1908. Specifications and forms of contract can be obtained at 15 Beacon Street, 9th floor. The right to reject any and all bids, and to award the contract as is deemed to be for the best interest of the City of Boston is reserved. By order of the BOSTON TRANSIT COMMISSION, B. LEIGHTON BEAL, Secretary.

Situations Wanted

MECHANICAL ENGINEER, six years in charge of mechanical equipment of large industrial plant, nine years in the design and installation of power, heating, ventilating and refrigerating plants; recently executive for an engineering house located in N. Y. City, is open for an engagement; experienced solicitor, estimating engineer and buyer. Have been handling per annum contracts to the value of $80,000 to $140,000. Address "C. A. 25," Engineering News, New York. 25-1t

Situations Open

CEMENT TESTER—Want a man familiar with testing and analysis of cement to take charge of laboratory. State salary expected and give experience in detail. Address "T. A. 25," Engineering News, Chicago. 25-1t

Miscellaneous Wants

WANTED—Partners abroad to introduce a novelty (U. S. Patent 903,909): STEINERS CRACKLESS REINFORCED CONCRETE. Partner to pay cost and receive half net profit in his country. CHARLES R. STEINER, Box 214, Gridley, Cal. 25-4t

AN ENGINEER, resident in Ireland, is open to accept first-class agencies; highest references. Apply WM. BOUTTON CONYRHAM, 78 Hudson St., New York. 25-1t

WHEN WRITING ADVERTISERS.

Every advertiser is rather interested to know how you got his name, and we would suggest that when you write, you state that you secured it from the advertisement in

ENGINEERING NEWS